Municipal Engineering

Design, Construction, Operation and Maintenance of All Public Works

Vol. LIV. FEBRUARY, 1918. No. 2

CONTENTS.

Editorials 47

For Military Highways and Main Market Roads—Shall We Encourage a Revival of Sectionalism?—Meterage for Chicago Again Recommended—The Farmer and Road Machinery—Over Three Thousand.

General Articles 49

Details of the Design and Construction of the Water Supply of Camp Meade, Md., 79th National Army Division—Military Roads Essential—Ten Billions of Farm Products and Only Five Per Cent. of Good Roads.

Pavement Design and Construction..... 52

Data on Operation of Asphalt Mixing Plant Owned by City of Worcester, Mass.—Specifications for Asphalt-on-Concrete-Base Road Construction—Careless Construction Causes Early Failure of a Brick Pavement—Approved Practice in the Construction of Granite Block Pavements.

Water Works Design and Construction..... 57

Breadth of View in Water Works Design—Rivers as Sources of Water Supply.

Refuse Collection and Disposal..... 60

Operation of High Temperature Incinerator Plant at Savannah for Three Years and Nine Months.

Sewer Design and Construction..... 62

Some Practical Hints on the Design and Construction of Sanitary Vitrified Pipe Sewers—Sewers: When to Build and How to Pay.

Bridges and Buildings..... 67

The Franklin Street Reinforced Concrete Bridge, Waterloo, Ia.—New Club Building of the Engineers Club of Dayton.

Water Purification and Sewage Treatment.. 68

The Electro-Chemical Sewage Treating Process as Operated at Decatur, Ill., in 1916.

From Workers in Field and Office..... 73

Pettis County, Missouri, Highway Bridges—Experience with Motor Street Flushers in Bethlehem, Pa.—Light Canvas Strips for Floating Concrete Pavement—Experience With Tractor Grading Outfits in Miller County, Mo.—Gasoline Engine Efficiency—Using Steam Jets to Thaw 3 Ft. of Frost.

Plant Units and Lay Outs..... 76

The One-Man Collapsible Culvert Form—Conspicuous Success of Road Building Entirely by Machinery—Locking Cable-Way Carriage for Operating Clam-Shell Buckets on Cable-Ways—Successful Demonstration of New Motor Truck—A Round Nose Curb Bar—Contractor Adapts Building Concrete Mixer to Grouting—Economics of the Motor Truck Trailer—An Improved Trench Backfiller—Filtros Air Diffusing Plates Used in the Activated Sludge Process of Sewage Treatment—A Simple Recording Instrument for Measuring Water or Gas to Find Leakage—A Collapsible Wood Joist Form—The Eveready Saw Rig—A Portable Crusher Popular with Road Builders—A Satisfactory Sand-Sweeping Machine—Heltzel "Lightning" Loader Skips.

Advance Information on Big Jobs..... 81

The Proposed Military Highways of Texas—News of Prospective Work from State Highway Departments—Eight Southern States Will Spend $74,000,000 on Road Construction This Year—Some Major Construction Projects of the Sanitary District of Chicago for 1918—Sheridan Road Connecting Chicago and Milwaukee, to be Completed in 1918—Sanitary District of Chicago Offers Federal Government $475,000 to Build Controlling Works to End Lake Levels Controversy—A Definite Legislative Policy to Develop the Nation's Water Power.

MUNICIPAL ENGINEERING is published monthly by Engineering Publishing Company, 702 Wulsin Building, INDIANAPOLIS, INDIANA. A. P. Fox, President; C. A. Dickens, Vice President; H. J. Pritchard, Secretary.

The Editorial and Advertising Offices are at 538 S. Clark St., CHICAGO, ILLINOIS. Samuel C. Hadden, Editor. Charles A. Dickens, Advertising Manager. A. L. Marsh, Eastern Manager, 30 Church St., New York. H. B. Darlington, Western Advertising Manager.

Single copies, 25 cents. The yearly subscription price in the United States and its Possessions, Cuba and Mexico, is $2.00; in Canada, $2.40; and in all other countries, $2.75.

Entered at the Post-Office, Indianapolis, Indiana, as Second-Class Matter.

Changes of address, subscriptions and remittances should be addressed to MUNICIPAL ENGINEERING, Indianapolis, Indiana. Editorial and business communications should be addressed to 538 S. Clark St., Chicago, Illinois.

Building Right

A road is built from the foundation to the top course just as a house rests on its foundation and is covered by its roof. The foundation must support the weight of the structure and the use it is put to, and the top must shed the water and preserve the interior.

AUSTIN-WESTERN EQUIPMENT

builds correctly from foundation to top. Western Wheeled Scrapers, Western Graders and Plows form the best road bed; Austin-Western Rock Crushers, Screens, Etc., prepare the material for each course in the best manner. Austin Road Oilers and Sprinklers bond the top perfectly under the action of Austin Road Rollers.

A well-balanced plant made to work in harmony throughout is a time, money and labor saver. Made and sold by the one old established firm direct from factory to user, and under guarantee, is a sound way to do business and the best protection to the purchasers.

The photo above illustrates the solid, uniform work done by an Austin-Western equipment.

Our new General Catalogue is on the press—Send for it.

Austin-Western Road Machinery Company — CHICAGO

BRANCH OFFICES: New York, St. Paul, Columbus, Ohio; Dallas, Los Angeles, Salt Lake City; Portland, Ore., Atlanta, Wahoo, Neb.; San Francisco, Memphis, Jackson, Miss.

Penetration

These two products have proved their superiority

The success of this company is due above all to one thing —*dependable quality*. Every Reilly product—from first to last—has been made to do its work *better* than it could be done by any other product known to science.

Reilly creosote oils have never been by-products of the production of other materials. Hence it has been possible for us to turn out products that were both *uniform* and *perfect* in quality.

For this reason, our two most recent and most meritorious products have received generous and serious consideration on the part of those interested in the preservation of wood.

Reilly's Improved Creosote Oil

(PATENTED)

The finest fruit of over twenty years experience. Superior to any previous creosote oil for use with the empty cell process.

Absolutely free from the volatile oils, coal tar or other adulterants. Contains more than *three times as much* permanent properties as the next best oil. At 250 degrees C. less than 1% distills. And at 315 degrees C. more than 75% remains undistilled. So permanent is its nature that it *stays in the wood forever*.

Reilly's Wood Preservative Oil

(PATENTED)

By far the best creosote oil ever produced for open tank or brush treatment. Produced by a patented process that gives this oil a much *higher boiling point* than any other pure creosote oil product.

Freedom from the volatile oils and precipitates gives it deepest and most *permanent* penetration.

Absolutely proof against the action of heat, cold, drought, water, decay and insect attacks. It coats the surface and fills the wood structure with an impermeable mass of permanent oil. We have the goods and can make prompt shipments. Especially good delivery in tank cars. Write for prices and samples for test. No other refinery is manufacturing these grades of creosote oil as our process is patented.

Republic Creosoting Company

Indianapolis, Indiana

PLANTS: Indianapolis Minneapolis Mobile Seattle

Permanence

BUYERS' GUIDE

Armor Plates.
Trussed Concrete Steel Co.

Asphalt.
Barber Asphalt Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
Uvalde Asphalt Paving Co.
Warren Asphalt Paving Co., The

Asphalt Filler.
Barber Asphalt Paving Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
Warren Bros. Co.

Asphalt Floors.
Warren Bros. Co.

Asphalt Machinery.
Alger Supply Co.
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The

Asphalt Plants.
Barber Asphalt Paving Co.
East Iron & Machine Co., The
Warren Bros. Co.

Asphalt Railroad Plants.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Asphalt Surface Heaters.
Alger Supply Co.

Asphalt Tools.
Alger Supply Co.
Barber Asphalt Paving Co.
Warren Bros. Co.

Asphalt Tool Wagons.
Alger Supply Co.

Auto Fire Apparatus.
Acason Motor Truck Co.
Acme Motor Truck Co.
American Motor Truck Co.
Columbia Motor Truck & Trailer
Couple-Gear Freight-Wheel Co.
Detroit Truck Co.
Garford Co., The
General Motors Truck Co.
Gramm-Bernstein Motor Truck Co.
Hayward & Co., The S. F.
Hurlburt Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Master Trucks, Inc.
Pierce-Arrow Motor Car Co.
G. A. Schacht Motor Truck Co.
Service Motor Truck Co.
Signal Motor Truck Co.
South Bend Motor Works.
United Motors Co.
United States Motor Truck Co.
J. C. Wilson Co.

Automobiles.
American Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Pierce-Arrow Motor Car Co.
United States Motor Truck Co.

Back Fillers.
Pawling and Harnischfeger.

Bar Benders.
Koehring Machine Co.

Bar Cutters.
Koehring Machine Co.

Bars, Reinforcing.
Trussed Concrete Steel Co.

Binders, Road.
Barber Asphalt Paving Co.
Barrett Co., The
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros. Co.

Blasting Powder.
E. I. DuPont De Nemours & Co.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Bridges.
Lewis-Hall Iron Works.

Buckets, Dredging, Excavating and Sewer.
Pawling and Harnischfeger

Buckets, Dumping.
Pawling and Harnischfeger

Building Stone.
Ohio Quarries Co., The

Calculators.
The Calculator Corporation.
Kolesch & Co.

Carriers.
Mathews Gravity Carrier Co.

Car Unloaders.
Heltzel Steel Form & Iron Co.

Carts, Street Cleaners.
Holzbog & Bro., Geo. H.

Castings.
American Cast Iron Pipe Co.
Warren Foundry & Machine Co.

Cast Iron Pipe.
American Cast Iron Pipe Co.
Warren Foundry & Machine Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement.
Atlas Portland Cement Co.
The Barrett Co.

Cement Testing.
Hunt & Co., R. W.
Kirschbraun, Lester.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Chemical Tests.
Hunt Co., R. W.

Chimneys, Concrete.
Trussed Concrete Steel Co.

Chimneys, Steel.
Lewis-Hall Iron Works.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Chutes, Concrete.
Heltzel Steel Form & Iron Co.

Concrete Mixers.
Koehring Machine Co.
Pneumatic Concrete Machinery Co.

Concrete Placing Machinery.
Pneumatic Concrete Machinery Co.

Concrete, Reinforcement.
Trussed Concrete Steel Co.

Conduits.
Cannelton Sewer Pipe Co.
Trussed Concrete Steel Co.

Conduit Rods.
Stewart, W. H.

Conduits, Wood, Creosoted.
Republic Creosoting Co.

Consulting Engineers.
Alvord, John W.
Brossmann, Chas.
City Wastes Disposal Co.
Colby, B. H.
Collins, Charles E.
Dow & Smith.
Howard, J. W.
Hunt Co., R. W.
Jones, Sam L.
Kirschbraun, Lester.
Potter, Alexander
Shields, W. S.
Van Trump, Isaac

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty
Warren Bros. Co.

Contractors' Tools and Machinery.
Alger Supply Co.
Austin-Western Co., Ltd., The
Barber Asphalt Paving Co., The
Buffalo Springfield Roller Co.
Holzbog & Bro., Geo. H.
Littleford Bros.

Contractors' Wagons.
Austin-Western Co., Ltd., The
Holzbog & Bro., Geo. H.

Conveying Machinery.
Mathews Gravity Carrier Co.
Pawling and Harnischfeger.
Pneumatic Concrete Machinery Co.

Cranes and Hoists.
Heltzel Steel Form & Iron Co.
Pawling and Harnischfeger

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Jennison-Wright Co.
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co., The

Crushed Stone.
Cleveland Stone Co., The
Ohio Quarries Co.

Culvert Forms.
Storms Manufacturing Co.

Culvert Molds.
Austin-Western Co., Ltd., The

Culvert Pipe, Cast Iron.
American Cast Iron Pipe Co.
Warren Foundry & Machine Co.

Culvert Pipe, Vitrified.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Armco Iron Culvert & Flume Mfrs. Assoc.
Trussed Concrete Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Trussed Concrete Steel Co.

Curb Bar.
Trussed Concrete Steel Co.

Curbing, Sandstone.
Cleveland Stone Co., The
Ohio Quarries Co., The

Drain Tile.
Dee Clay Mfg. Co., W. E.
Rosing, A. S.

Dryers.
Barber Asphalt Paving Co., The

Dump Boxes.
Cummer & Son Co., The F. D.

Dump Cars.
Austin-Western Road Machinery Co., The

Dump Carts.
Holzbog & Bro., Geo. H.

Dump Wagons.
Austin-Western Road Machinery Co., The
Holzbog & Bro., Geo. H.

Dust Laying Compound.
The Barrett Co.
Standard Oil Co. (Indiana)

Dynamite.
E. I. DuPont De Nemours & Co.

Edge Protector.
Trussed Concrete Steel Co.

Elevators (Automatic Brick).
Mathews Gravity Carrier C.o

Engines.
Wisconsin Motor Mfg. Co.

Engineering Instruments.
Lufkin Rule Co., The

Excavating Machinery.
Koehring Machine Co.
Pawling and Harnischfeger.

Expansion Joints.
Pioneer Asphalt Co.

Expansion Joint Compound.
The Barrett Co.
Pioneer Asphalt Co.
Rosing, A. S.
Trussed Concrete Steel Co.

Explosives.
E. I. DuPont, De Nemours & Co.

Fillers (Paving Joint).
The Barrett Co.
Pioneer Asphalt Co.

Financial News.
The Bond Buyer.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Fire Department Supplies.
Hayward & Co., S. F.

Fireproofing.
Rosing, A. S.

Flooring (Bridges).
Jennison-Wright Co.

Flooring (Factory).
Jennison-Wright Co.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.
McNutt. Lewis

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Trussed Concrete Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Trussed Concrete Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction, Etc.).
Heltzel Steel Form & Iron Co.

Foundations.
Heltzel Steel Form and Iron Co.

Garbage Disposal Plants.
City Wastes Disposal Co.

Gas Pipe.
American Cast Iron Pipe Co.
Warren Foundry & Machine Co.

Gasoline and Kerosene Pumping Engines.
Wisconsin Motor Mfg. Co.

Gas Pipe.
American Cast Iron Pipe Co.

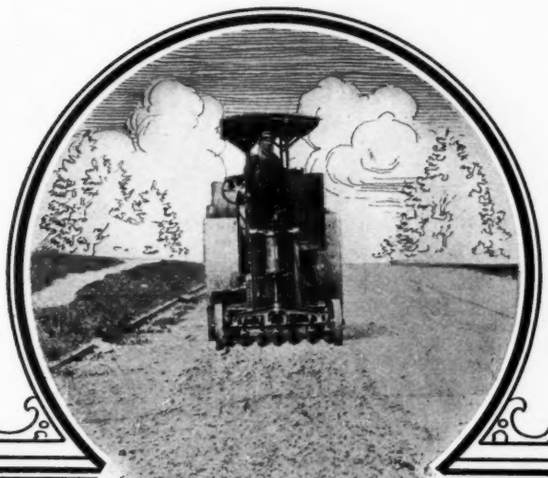
Graders.
Austin-Western Road Machinery Co., The

Graders, Elevating.
Koehring Machine Co.

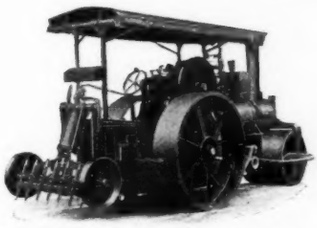
Graders, Turbine.
Koehring Machine Co.

Heaters (Rock and Sand).
Barber Asphalt Paving Co., The
Littleford Bros.

Heating Wagons (Oil and Tar).
Littleford Bros.

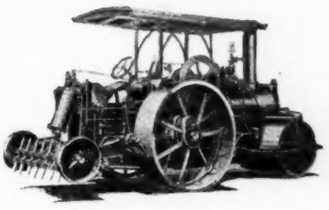


Buffalo-Springfield



Standard 10-Ton Kelly Steam Macadam Roller with Attached Scarifier.

"The Buffalo-Springfield Pneumatic Scarifier Attachment is superior to any other scarifier we know of."



Standard 10-Ton Buffalo-Pitts Macadam Roller with Attached Scarifier.

"That's the experience of Passaic County," states Mr. Garwood Ferguson, County Engineer, "and we intend to equip ***all*** of our steam rollers with the Buffalo-Springfield Pneumatic Scarifier Attachment.

"It is an ***economical*** device for use in County Highway Construction and Maintenance as well as in preparing roads for oiling.

"The direct connected compression cylinder exerts a force sufficient for tearing a six-foot swath through the ***hardest*** macadam and stone roads.

"Its long stroke gives all the elasticity required to maintain a ***uniform*** cutting depth on extremely uneven surfaces.

"With the Buffalo-Springfield Pneumatic Scarifier Attachment we have been able to do from Three to Five Times The Work of any other scarifying method we've ever tried out."

Enters work instantly upon opening valve lever. Raises ***automatically*** upon striking hidden obstacles. Operator can raise scarifier instantly upon passing over cross-walks, manhole covers, etc.

Buffalo-Springfield Roller Co.

SOLE MANUFACTURERS OF BUFFALO-PITTS AND KELLY-SPRINGFIELD ROLLERS

SPRINGFIELD OHIO

BUYERS' GUIDE

Hex Block.
Jennison-Wright Co.

Hoists (Concrete, Gasoline and Hand).
Pawling and Harnischfeger.

Hoists, Electric.
Pawling and Harnischfeger.

Hoists, Steam.
Lewis-Hall Iron Works.

Hose.
Hayward & Co., S. F.

Hot Mixers.
Koehring Machine Co.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Joint Fillers (Paving).
Pioneer Asphalt Co.

Kettles (Portable).
Barber Asphalt Paving Co., The
Cummer & Son Co., The F. D.

Kreolite Lug Block.
Jennison-Wright Co.

Laboratory.
Chicago Testing Laboratory.
Kirschbraun, Lester.
Hunt & Co., R. W.

Lamp Posts.
Cutter Co., Geo.

Landscape Engineers.
Brown, Mason L.

Loaders, Wagon.
Mathews Gravity Carrier Co.

Locomotives.
Bell Locomotive Works, Inc.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
Pioneer Asphalt Co.

Meter Boxes.
Ford Meter Box Co., The

Meter Testers.
Ford Meter Box Co., The

Mixers, Asphalt.
Barber Asphalt Paving Co., The
Cummer & Sons Co., The F. D.
Koehring Machine Co.

Mixers, Concrete.
Barber Asphalt Paving Co., The
Koehring Machine Co.
Pneumatic Concrete Machinery Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motors.
Wisconsin Motor Mfg. Co.

Motor Fire Apparatus.
Acason Motor Truck Co.
Acme Motor Truck Co.
American Motor Truck Co.
Columbia Motor Truck & Trailer Co.
Couple-Gear Freight-Wheel Co.
Detroit Truck Co.
Garford Motor Truck Co.
General Motors Truck Co.
The Gramm-Bernstein Motor Truck Co.
Hayward & Co., S. F.
Hurlburt Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Master Trucks, Inc.
Pierce-Arrow Motor Car Co.
G. A. Schacht Motor Truck Co.
Service Motor Truck Co.
Signal Motor Truck Co.
South Bend Motor Car Works
United Motors Co.
United States Motor Truck Co.
J. C. Wilson Co.

Motor Trucks.
Acason Motor Truck Co.
Acme Motor Truck Co.
American Motor Truck Co.
Couple-Gear Freight-Wheel Co.
Columbia Motor Truck & Trailer Co.
Detroit Truck Co.
Duplex Truck Co.
Garford Motor Truck Co., The
General Motors Truck Co.
The Gramm-Bernstein Motor Truck Co.
Hurlburt Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Master Trucks, Inc.
Pierce-Arrow Motor Car Co.
G. A. Schacht Motor Truck Co.
Service Motor Truck Co.
Signal Motor Truck Co.
United Motors Co.
United States Motor Truck Co.
J. C. Wilson Co.

Motor Truck Ambulances and Patrols.
Acason Motor Truck Co.
Acme Motor Truck Co.
American Motor Truck Co.
Columbia Motor Truck & Trailer Co.
Detroit Truck Co.
Garford Motor Truck Co., The
General Motors Truck Co.
The Gramm-Bernstein Motor Truck Co.
Hurlburt Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Master Trucks, Inc.
Pierce-Arrow Motor Car Co.
G. A. Schacht Motor Truck Co.
Service Motor Truck Co.
Signal Motor Truck Co.
South Bend Motor Car Works.
United Motors Co.
United States Motor Truck Co.
J. C. Wilson Co.

Motor Truck Flushers and Sprinklers.
Acason Motor Truck Co.
Acme Motor Truck Co.
American Motor Truck Co.
Columbia Motor Truck & Trailer Co.
Detroit Truck Co.
Garford Motor Truck Co., The
General Motors Truck Co.
The Gramm-Bernstein Motor Truck Co.
Hurlburt Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Master Trucks, Inc.
Pierce-Arrow Motor Car Co.
G. A. Schacht Motor Truck Co.
Service Motor Truck Co.
Signal Motor Truck Co.
United Motors Co.
United States Motor Truck Co.

Motor Truck Oilers.
Acason Motor Truck Co.
Acme Motor Truck Co.
American Motor Truck Co.
Columbia Motor Truck & Trailer Co.
Detroit Truck Co.
Garford Motor Truck Co., The
General Motors Truck Co.
The Gramm-Bernstein Motor Truck Co.
Hurlburt Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Master Trucks, Inc.
G. A. Schacht Motor Truck Co.
Service Motor Truck Co.
Signal Motor Truck Co.
United Motors Co.
J. C. Wilson Co.

Municipal Castings.
Dee Co., Wm. E.

Natco.
National Fire Proofing Co.

Packing.
Pioneer Asphalt Co.

Paints.
The Barrett Co.
Pioneer Asphalt Co.
Trussed Concrete Steel Co.

Paints, Asphalt.
Barber Asphalt Paving Co., The
Pioneer Asphalt Co.

Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

Paving Brick.
Clinton Paving Brick Co.
Dunn Wire-Cut Lug Brick Co., The
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
Springfield Paving Brick Co.

Paving Contractors.
Barber Asphalt Paving Co.
Warren Bros. Co.

Paving Joint Compound.
Pioneer Asphalt Co.
Trussed Concrete Steel Co.

Paving Joint Filler.
Barber Asphalt Paving Co., The
Pioneer Asphalt Co.

Paving Machines.
Barber Asphalt Paving Co., The
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Koehring Machine Co.
Warren Bros. Co.

Paving Plants (Asphalt).
Barber Asphalt Paving Co., The
Cummer & Son Co., The F. D.
East Iron & Machine Co.
Koehring Machine Co.
Warren Bros. Co.

Pipe Cutters.
Strickler & Bro., W. W.

Pipe Dip and Coatings.
Barber Asphalt Paving Co., The
The Barrett Co.
Pioneer Asphalt Co.

Pipe Manufacturers.
American Cast Iron Pipe Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Mach. Co.

Portable Paving Plants.
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Koehring Machine Co.
Warren Bros. Co.

Powder.
DuPont, DeNemours & Co., E. I.

Pumps (Contractors).
Holzbog & Bro., Geo. H.

Reinforcing For Pavements.
Trussed Concrete Steel Co.

Road Binder.
Barber Asphalt Paving Co., The
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Road Forms.
Heltzel Steel Form & Iron Co.
Trussed Concrete Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The

Road Machinery.
Austin-Western Road Machinery Co., The
Buffalo Springfield Roller Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Koehring Machine Co.
Warren Bros. Co.

Road Oils and Preservatives.
The Barrett Co.
DuPont Chemical Co.
Barber Asphalt Paving Co., The
Standard Oil Co. (Indiana)

Road Rollers.
Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.
Buffalo Springfield Roller Co.

Road Scarifiers.
Austin-Western Road Machinery Co., The

Rock Crushers.
Austin-Western Road Machinery Co., The

Rock and Sand Heaters.
East Iron & Machine Co., The

Roof Coating.
DuPont Chemical Co.

Roofing Material.
Barber Asphalt Paving Co., The
The Barrett Co.
DuPont Chemical Co.
Pioneer Asphalt Co.
Warren Bros.

Sand.
Rosing, A. S.

Sand Dryers.
Barber Asphalt Paving Co. (Iroquois Works)
Cummer & Son Co., The F. D.

Sandstone.
Cleveland Stone Co.
Ohio Quarries Co.

Sanitary Carts.
Holzbog & Bro., Geo. H.

Scarifiers.
Austin-Western Road Machinery Co., The
Buffalo Springfield Roller Co.

Scrapers, Drag Line.
Pawling and Harnischfeger.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co.

Segment Block.
National Fire Proofing Co.

Sewage Disposal.
City Wastes Disposal Co.

Sewage Pumps.
Holzbog & Bro., Geo. H.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.

Sewer Castings.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

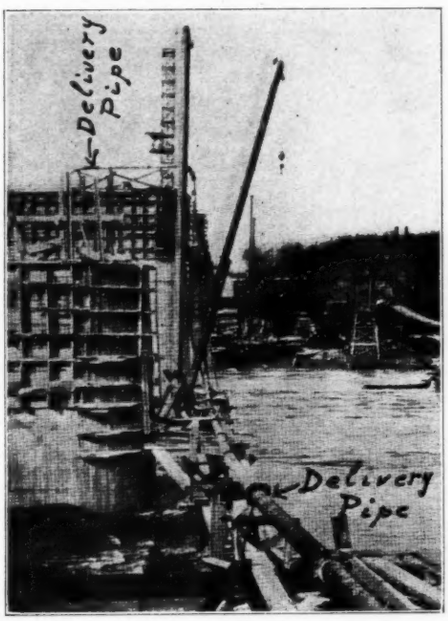
Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Bannon Sewer Pipe Co., P.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.
McNutt, Lewis.
Rosing, A. S.
Schaeffer & Gengnagle.

Sewer Rods.
Stewart, W. H.

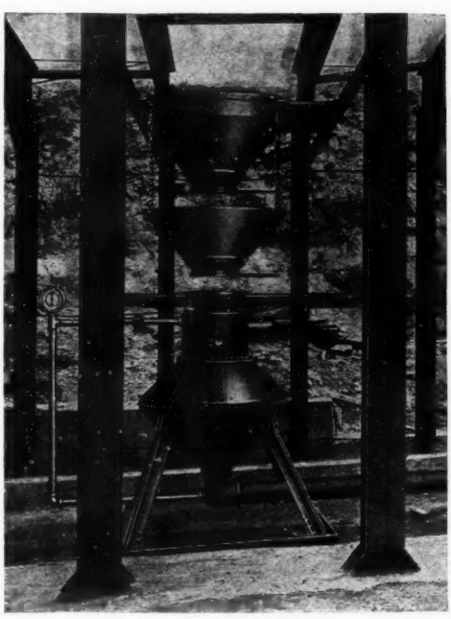
Sewer Tile.
National Fire Proofing Co.

"THE Man with the Hoe" has Gone! And so must all other inefficient and costly methods of mixing and placing concrete. Human muscle wheelers are being eliminated—compressed air "gets it there" and *right where you want it!* And on the *double quick!*



No more conveying of concrete from mixer to forms via barrow and cart! No more hoisting of the concrete to towers high in the air and then conveying it by gravity through long metal troughs!

THE NEW PNEUMATIC PROCESS not only *more thoroughly* mixes your concrete but it places this concrete (in same uniform condition of mix) *Anywhere* on the Job. No matter how far distant from mixer the forms may be situated—no matter how difficult of access (horizontal or vertical)—your concrete goes to the *exact* spot.



The conveying line used is an ordinary 6-inch wrought iron or steel pipe. Any degree of curvature can be introduced into the discharge line without danger of stoppage. The discharge line terminates in a specially constructed nozzle which permits the concrete to be deposited wherever required.

Let us send you complete illustrated particulars.

Pneumatic Concrete Machinery Co.

(Manufacturers of Pneumatic Conveying and Placing Equipment)

2 Rector St. New York City.

BUYERS' GUIDE

Sidewalks (Stone).
Cleveland Stone Co.
Ohio Quarries Co., The

Sign Posts.
Cutter Co., Geo.

Sluice Gates.
Coldwell-Wilcox Co.

Sprinklers.
Austin-Western Road Machinery Co., The

Steel Joists, Studs and Sash.
Trussed Concrete Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Curbing.
Cleveland Stone Co.
Ohio Quarries Co.

Stone Flagging.
Cleveland Stone Co.
Ohio Quarries Co., The

Street Cleaners' Carts.
Holzbog & Bro., Geo. H.

Street Cleaning Machinery (Horse Drawn).
Austin-Western Road Machinery Co., The

Street Crossings.
Cleveland Stone Co.
Ohio Quarries Co., The

Street Flushers (Horse Drawn).
Austin-Western Road Machinery Co.

Street Lighting.
Cutter Co., Geo.

Street Sprinklers (Horse Drawn).
Austin-Western Co., Ltd., The

Structural Steel.
Lewis-Hall Iron Works.

Surveyors' Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Sweepers.
Austin-Western Road Machinery Co., The

Tamping Machines.
Pawling and Harnischfeger.

Tar and Pitch.
The Barrett Co.
DuPont Chemical Co.

Tar Heaters.
Alger Supply Co.
Littleford Bros.

Tarvia.
The Barrett Co.

Testing Chemists.
Dow & Smith.
Howard, J. W.
Kirschbraun, Lester.
Van Trump, Isaac.

Testing Laboratories.
Howard, J. W.
Hunt & Co., R. W.
Lester Kirschbraun.
Tinius Olsen Testing Machine Co.

Traction Engines.
Austin-Western Road Machinery Co., The

Traction Engines (Oil or Kerosene).
Austin-Western Road Mach. Co.

Trench Braces.
Kalamazoo Fdy. & Mach. Co.

Trench Machinery.
Holzbog & Bro., Geo. H.
Kalamazoo Fdy. & Machine Co.
Pawling and Harnischfeger.

Trucks (Motor).
Acason Motor Truck Co.
Acme Motor Truck Co.
American Motor Truck Co.
Columbia Motor Truck & Trailer Co.
Couple-Gear Freight-Wheel Co.
Detroit Truck Co.
Duplex Truck Co.
Garford Motor Truck Co., The
General Motors Truck Co.
The Gramm-Bernstein Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Master Trucks, Inc.
Pierce-Arrow Motor Car Co.
G. A. Schacht Motor Truck Co.
Service Motor Truck Co.
Signal Motor Truck Co.
United Motors Co.
United States Motor Truck Co.
J. C. Wilson Co.

Valves.
Coldwell-Wilcox Co.

Wall Coping.
Cannelton Sewer Pipe Co.

Warrenite.
Warren Bros. Co.

Water Pipe.
American Cast Iron Pipe Co.
Warren Foundry & Machine Co.

Waterproofing.
Barber Asphalt Paving Co., The
Barrett Co., The
Pioneer Asphalt Co.
Trussed Concrete Steel Co.

Water Purification.
Pennsylvania Salt Mfg. Co.

Water Works Supplies and Equipment.
American Cast Iron Pipe Co.
Alger Supply Co.
Coldwell-Wilcox Co.
Pennsylvania Salt Mfg. Co.

Windows (Steel).
Trussed Concrete Steel Co.

Wire-Cut Lug Brick.
Dunn Wire-Cut Lug Brick Co.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
Southern Clay Mfg. Co.
Springfield Paving Brick Co.

Wood Block (Creosoted).
Barrett Co., The
Jennison-Wright Co.
Republic Creosoting Co.

Wood Preservatives.
Barber Asphalt Paving Co., The
Barrett Co., The
DuPont Chemical Co.
Jennison-Wright Co.
Pioneer Asphalt Co.
Republic Creosoting Co.

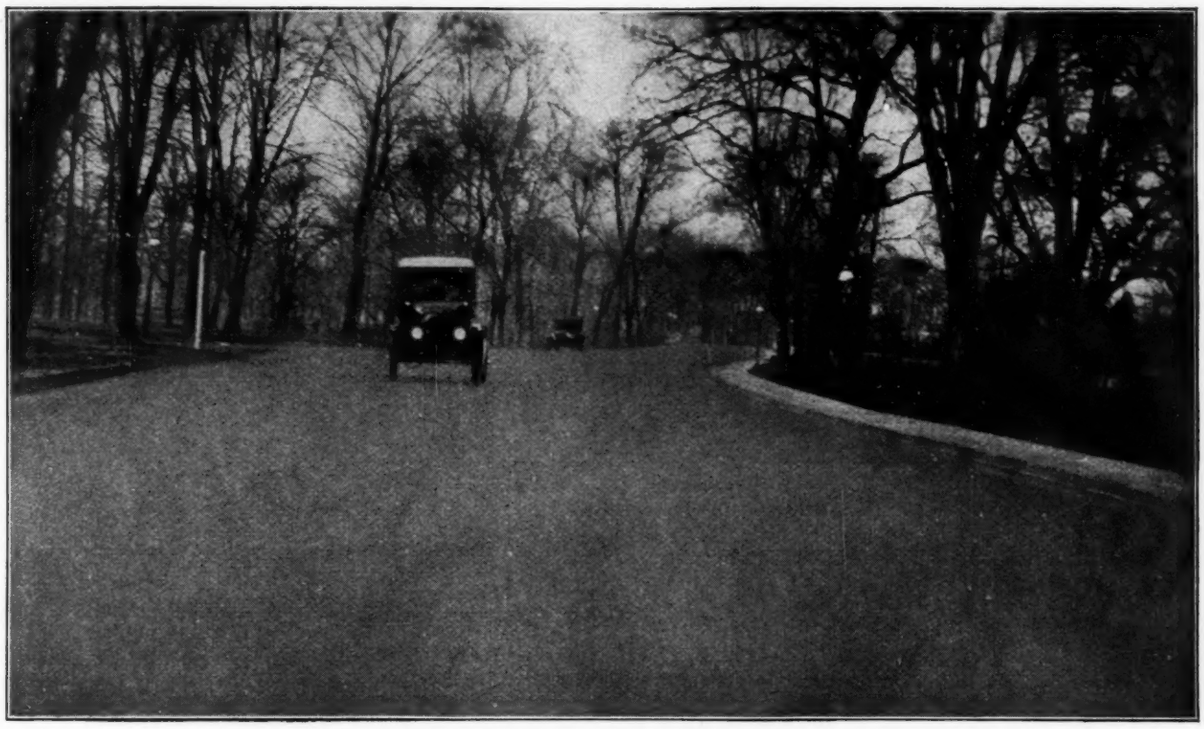
War's Backbone—Business!

"The one great business of this country today is war; and one of the greatest sources of strength of the country in this war is business."

The greatest wars of all times, up to those of the present, were those of Napoleon. Napoleon placed great reliance on business as the mainstay of his campaigns. He did not lose an opportunity to impress on his people the necessity of keeping their industries busy, their commerce active. He knew that this economic support was indispensable.

In this war we need a great optimism. A determination to keep things moving, to progress and to win, no matter what it costs. Wastage we must and will stop, but false economy not only can do no good, but will do actual harm.

The Standard Way



FOREST PARK, ST. LOUIS, MISSOURI.
STANOLIND PAVING ASPHALT.

Stanolind Paving Asphalt

produced under a new and patented process, furnished in all consistencies suitable for

SHEET ASPHALT
ASPHALTIC MACADAM

ASPHALTIC CONCRETE
Also Seal Coats for Water Bonded Roads

OTHER ROAD PRODUCTS

Standard Macadam Asphalt Binder B.
Standard Paving Filler.
Standard Macadam Asphalt Binder C.
Standard Asphalt Road Oils Nos. 3, 4, 5 and 6.

Booklet with full information and detailed specifications sent upon request.

STANDARD OIL COMPANY
(INDIANA)

72 West Adams Street. **CHICAGO, U. S. A.**

Lower the Cost of Grading—Speed Up the Spading!

A Pennsylvanian contractor was "up against" a time contract, labor shortage and very hard excavating. By using low-strength dynamite to

Blast Ahead of Shovels

they handled the gravel and shale easily and quickly and the contract was completed on time.

With a few cartridges of Red Cross Extra Dynamite exploded ahead of the shoveling gangs, it takes less time and labor and yardage per day increases. Blasting takes the strain off the steam shovel, helps it to dig faster, cheaper and easier.

Ask for free booklet, ***"Road Construction and Maintenance."*** Learn how to use Red Cross Explosives to lower the cost of grading and speed-up spading. Mention "Municipal Engineering" and address Advertising Division

LOWERING COST OF HARD-ROAD GRADING.

A contractor on a Pennsylvania road has completed his work at a lower cost than was attained on other sections of the road by using machinery to an unusual extent. On account of the high price of labor and its scarcity, he used a steam shovel in all cuts, low-strength dynamite to loosen the material and speed up the work of the shovel, and automatic dump wagons to remove the earth and shale as it was excavated. The outfall drainage ditches were blasted out with dynamite, thereby reducing the cost of excavation and of trimming the slopes.

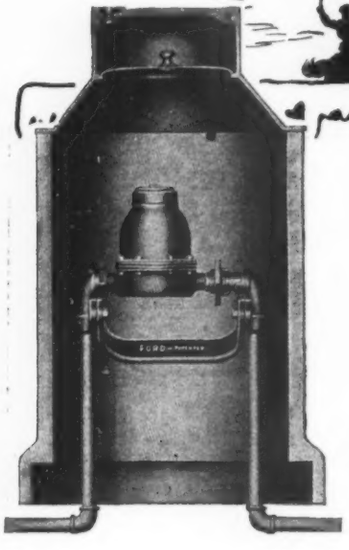
The work was finished on time, in addition to being done at a relatively low figure for the conditions, while the other contractors were unable to do so because of the difficulty of securing labor by the older methods, utilizing plows, scrapers and hand work.

E. I. du Pont de Nemours & Co.
Powder Makers Since 1802
Wilmington, Delaware

DU PONT

NOTE
When in Atlantic City, visit the Du Pont Products Store, Boardwalk and Penn. Avenue.

DU PONT



The Ford Yoke makes connection with the meter in such an easy and simple manner that it will meet with your favor the moment you see it.

THE Icy Drives of Severe "below zero" weather will not affect the delicate mechanism of your water meters —if they're ***protected*** by **Ford Meter Boxes.** A meter properly installed in a **Ford Meter Box** has ***never*** frozen.

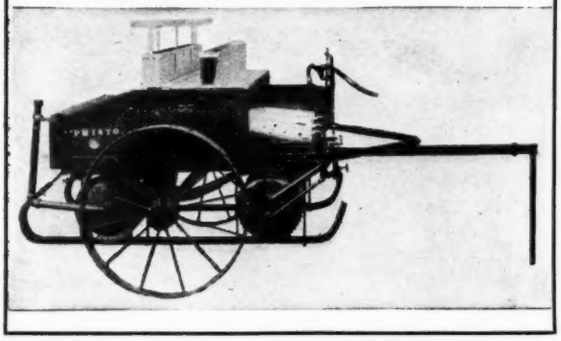
Ford Meter Box Lids lock in any position! Simply turn the "worm" and it's ***sealed tight*** for keeps —a mere reverse twist and the lid's unlocked! The wonderful ***simplicity*** and ***rapidity*** of removing or replacing meters is still another advantage you get with **Ford Meter Boxes!**

The FORD METER BOX Co.
WABASH, INDIANA, U.S.A.

NEW PAVEMENTS FROM OLD ONES!

PHISTO TOOL FURNACE

On a consumption of 3 gals. of kerosene per hour, the **"Phisto"** Tool Furnace will keep fourteen tools, three pails of binder and three shovel scoops constantly hot. It gives a cleaner flame of more intense heat than can be produced by any wood burning furnace and does away with the trucking of wood and ashes.



Resurface your old asphalt, brick and cobble pavements with the **"Pluto"**—it will heat 36 sq. ft. of sheet asphalt surface to a proper consistency for handling in from 5 to 7 minutes. The first cost of the **"Pluto"** is small, and so is its operating cost. One man operates it and the fuel required is 6 gals. of kerosene per hour. A special type is built for working close to car tracks.

We have a full line of Surface Heaters, Tool Furnaces, Babbitt Burners, Torches and other special kerosene vapor burners.

Write for Illustrated Circular

ALGER SUPPLY COMPANY

Peoples Gas Building **CHICAGO, ILL.**

The Key to Low-Cost Tamping

"MEN are scarce," says a leading contractor, "but our 'P & H' Power Traction Tamper does the work of *eighteen* of them!

"And at a saving of approximately $5.60 per hour—that's why our tamping costs are so *low*. This machine strikes 42 (twenty-six inch) blows with its 150-pound ram each and every working minute—and *Keeps It Up All Day Long*. Our work is all done under guarantee, and thanks to the 'P & H' tamper we've *never* had any trouble through pavement settlings."

Get details about the "P & H" Power Traction Tamper. You ought to be acquainted with this "slam-banger."

Pawling & Harnischfeger Co.

MILWAUKEE, WIS.

Paved and Curbed in 1906

This Cleveland Street could not stand its twelve years of traffic—but its Natural Sandstone Curbing is as good as new. When this street is re-paved the curbing will be re-set. (Photo taken August, 1917.) If you are interested in a Permanent Curbing, you are interested in

"BUCKEYE BEREA"

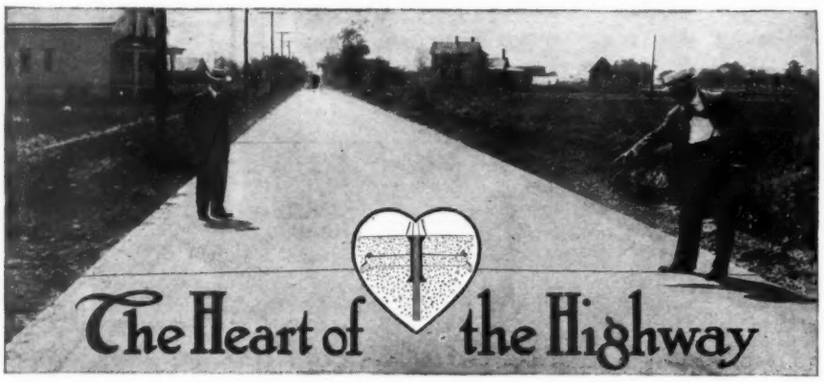
Natural Sandstone Curbing! The selected best of Nature's finest product. It resists the extremes of temperature, and because of its low absorptive power Does Not Discolor or Chip or Crack! No "ifs" to be reckoned with in its construction, and no Hidden flaws to cause trouble afterwards. You know what you've bought before you lay it—and you know you can depend upon it to outwear the best pavement ever devised.

THE OHIO QUARRIES COMPANY

CLEVELAND

When you lay a Permanent Pavement, why not protect it with a Permanent Curbing? That's **Buckeye Berea Natural Sandstone Curbing.**

KAHN Building Products

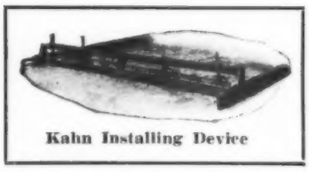


KAHN Building Products

Kahn Armor Plates

THE joint in the concrete pavement determines its success. Protect the joint with the bevel-edged Kahn Armor Plates and you are sure the concrete cannot break down or chip away. Install the plates with our improved installing device and accuracy is assured. Reinforce the pavement with Kahn Mesh to prevent cracks in the roadway. If there are concrete curbs, reinforce and protect them with Kahn Curb Bars.

Kahn Road Mesh



Kahn Installing Device

Kahn Road Book—a highway handbook—free on request. Write for our literature.

TRUSSED CONCRETE STEEL CO.

Highway Department **Youngstown, Ohio**

Representatives in Principal Cities.

Kahn Curb Bar

MATHEWS CONVEYERS Save Us Money

"Two 16-foot Mathews Sections do away with *three* placers, *two* setters and *many* stackers—that's why they save us money.

"These sections:—(1) *Save us* many re-handlings! (2) ***Do away*** with tracking mud in on new laid pavement before filler is poured! (3) ***Eliminate*** necessity of wheelers! (4) ***Do away*** with chipping of brick through careless handling! (5) Make possible employment of cheaper labor! (6) ***Speed up*** paving brick construction."

This advertisement was written for us by the Boro of Farrell, Pa. Every word is taken verbatum from their report on the economical use of **Mathews Gravity Brick Conveyers.**

Mathews Gravity Carrier Co.
ELLWOOD CITY, PA.

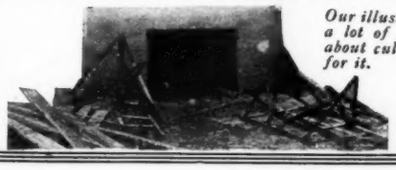
Here's the Way

To Build Concrete Culverts

No fussing with wood bracing which is a very slow and expensive method

Vastly Cheaper than Metal Pipe Culverts
and as cheap and more substantial than clay tile

The One-Man Collapsible Culvert Form

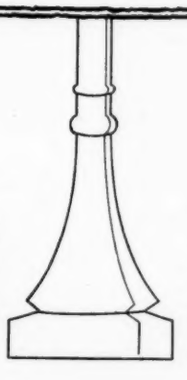


Our illustrated booklet contains a lot of valuable information about culvert building. Write for it.

STORMS MFG. CO.
52 W. VanBuren St.
CHICAGO.

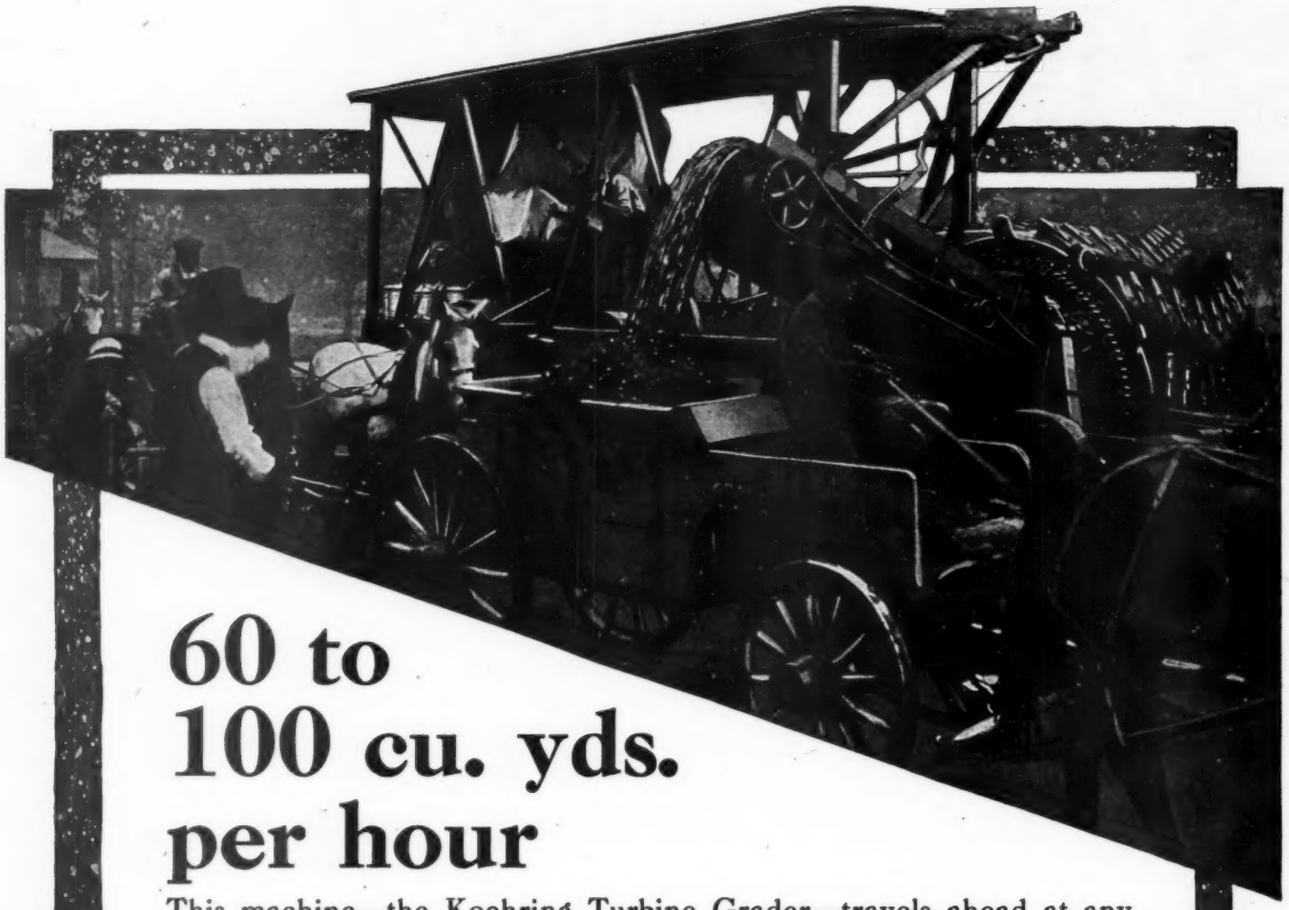
It is all right to say that "vehicles turning into cross-streets shall turn around intersection of the center lines of the two streets," but **CUTTER SIGNAL POSTS** ***eliminate guess work*** and ***prevent*** accidents by definitely marking the exact spot they must "turn round."

GEORGE CUTTER COMPANY
New York City SOUTH BEND, IND. Chicago



Night and day, rain or shine—that Ruby Red Globe eliminates traffic hazards. It is ***always*** on duty—in fair weather and in storm.

The high candle power warning can be seen great distances under worst weather conditions, and yet does not produce a glare.



60 to 100 cu. yds. per hour

This machine—the Koehring Turbine Grader—travels ahead at any of three speeds most suitable to the depth of the "cut."

The digging wheel is adjustable for "cuts" from two inches to two feet deep. The elevator is adjustable to load into wagon, truck or car.

Tough, Rubbery Clay Put on Wagons at .043 per cu. yd.

This was the cost on a Chicago job for cutting to grade and loading—and this is not a special record but the average for a nine-hour day—and this low cost is consistently maintained as the approximate average on job after job.

"Cuts Out" Old Macadam and Screens the Stone

No trouble to rip out and load old macadam, and a screen attachment will separate the stone.

For any street or average highway grading this machine is beyond all question the revolutionary cost cutter.

To be built in Limited Quantities for 1918 Delivery Schedule

During 1917 we could not meet several offered orders. It is not a unit for quantity production. Our 1918 production calls for a limited production, and we are taking orders for 1918 delivery. Send for illustrated descriptive circular.

KOEHRING MACHINE CO., Milwaukee, Wis.

The Highway Economist

VOL. III. FEBRUARY, 1918. NO. 9.

NEW ASPECTS OF PATRIOTISM PRESENTED BY WAR DEMANDS

The first year of the war has produced a readjustment of ideas of patriotism. In a sense, war has made necessary an almost entirely new conception of patriotism.

It was understood, in a vague sort of way, that fundamental patriotism meant willingness to sacrifice money, comfort and even life for the cause to which the nation devoted itself. This vague conception is becoming more clearly defined as the war progresses, but it by no means compasses the broad scope of patriotism. Patriotism is not a negation, a mere passive submission to sacrificial demands; it embraces active forms of duty in realizing the possibilities of productive energy and in carrying forward enterprises essential to the coordination of all available means for promoting national efficiency.

In time of war first thought must be given to military essentials; but military essentials have a more comprehensive inclusiveness than formerly, a breadth of inclusiveness which even those high in authority are only slowly beginning to grasp.

Miiltary essentials constitute a chain with many links, each link indispensable. Men to fight the battles are the first essential. Then come equipment and munitions. But men must be fed, so that the provisioning of the commissariat is as essential as the mobilizing of an army.

Back of munitions and equipment are the manufacturers, and back of the manufacturers are raw materials.

In provisioning an army the chain of essential links reaches back to the land, which produces the grain and the meat and the vegetables.

But the problem of transportation is encountered at every step. Raw materials must be transported to shop and mills and factories; finished products must be transported to central depots and terminal points. The products of the land must be sent to markets and thence forwarded to mills and factories and abattoirs, and ultimately to final destinations.

The transportation system, in order to be effective, must be vast and efficient. Promptness in delivery, either to assembling points or from distributing points, is imperative. The means of transportation must be flexible, economical and adequate.

Three systems of transportation are available for supplies—water, rail and highways.

Of these three, the highways are of first importance. Every pound of farm products must reach shipping points by means of highways. Highways are the feeders of rail and water routes. There are more than 2,200,000 miles of rural highways in this country, over which are transported—for the most part in wagons—the products of 6,361,502 farms, operated by 12,659,208 people, in 30,000 townships, in 48 states, and producing wealth in 1915 to the amount of $10,501,686,375, from 878,798,325 acres.

Of this vast mileage, less than 10 percent., or only about 200,000 miles, nominally, are improved, although a large percentage of improved roads were originally cheaply improved and have long since reverted to their original condition.

It is obvious to all who are familiar with rural road conditions that a vast network of roads, aggregating, perhaps, 95 percent. of all the rural roads in the nation, are practically closed to transportation traffic for several months each year, and never are in condition to facilitate the hauling of loads on an economical basis.

The supply of the nation and the sustenance of its armies abroad are, therefore, dependent upon this limited and enormously inefficient and inadequate means of transportation from the farms to the railroads—a means insufficient at all times and practically unserviceable for months at a time every year.

In addition, congestion of traffic far exceeds the facilities of railroads for handling freight, and waterways are frozen up for months during the winter season.

This condition is causing a heavy demand for highway transportation, a demand which can be met in isolated instances only.

In the circumstances it is clearly evident that the construction of durable highways in all parts of the country is not only a public necessity but it is a patriotic duty.

Patriotism could find no more helpful expression during the war than in bending every energy to supply adequate facilities for highway transportation of foodstuffs and other supplies of which the public is in sore need, and without which the armies of the United States cannot win.

Wire-Cut-Lug Brick Better for Soft Fillers than Are Repressed Paving Brick

It is now universally admitted by engineers and contractors who speak from experience and observation that wire-cut lug brick hold grout filler much more firmly than do repressed brick. The same features of wire-cut lug brick which assure a strong cement grout bond—that is to say, rough contact sides, uniform spacing and square edges—are effectual in holding a soft filler in place. Unless the soft filler is reduced to a very thin consistency by thermal influences, the rough sides of wire-cut lug materially check the tendency of the filler to flow toward the curb, while the square edges of the brick afford less opportunity for surface overflow than does a round-edge repressed brick.

The filler must rise higher in order to overflow the square edge of wire-cut lug brick, and it does not spread out as easily as it does over the

rounded radius of a repressed brick edge. As a vessel with vertical sides and sharp square brim will keep a fluid or liquid form from overflowing much more effectually than will a vessel having a rounded brim, so do the square edges and vertical joints of wire-cut lug brick retain soft fillers in the joints much better than do repressed brick with rounded edges.

These are points which engineers and contractors will appreciate, but the fact that wire-cut lug brick have been used almost exclusively for rigid types of construction has created the erroneous impression that these brick are unsuited for asphaltic and mastic fillers.

As a matter of fact, soft fillers have been used with wire-cut lug brick with the most satisfactory results, so satisfactory that the makers of a well-known proprietary filler themselves pronounce wire-cut lug brick superior to repressed for soft filler.

Getting Something for Nothing is an Iridescent Dream and It Doesn't Pay Well.

Getting something for nothing is an iridescent dream which has filled many minds with the illusions of hope. But realities are not of the stuff of which dreams are made. This is a practical age—an era of unsentimental utilitarianism. Business is business. Exchange of material things for cash is conducted upon the basis of value for value. If an article has real value, real cash of equal value must be put up.

Cheap stuff may carry a high price mark, but that is not in accordance with business ethics. It still is true that that which costs much to produce and has good value comes higher than that which costs little to produce and has little value.

Actual first cost is not, however, a measure of utility in all cases. Silk costs more than wool. Wool costs more than shoddy. Silk fabrics are suitable for special occasions and for appearance, for those who can afford frequent renewals of wardrobe. Wool wears better and is more serviceable for general use. Shoddy is a makeshift which neither lasts long nor looks well while it does last. Shoddy requires frequent repairs to keep it serviceable at all.

Silk is not adapted to hard usage.

So with road surfacing materials. Some materials are called "tony," because they look "nice" when new. Some of them come comparatively high, but for general use they are unserviceable—and they are maintained only at considerable expense.

Shoddy material in road making soon wears out and it entails continuous effort to maintain it during its short period of service.

Vitrified brick costs considerable money, but it wears a long time, and it serves the purpose of general traffic better than any other material.

In these times economy is expressd in terms of dependability and durability. Constructing pavements for looks and supposed refinement is like farmers buying silk jumpers or like farmers' wives buying silk dresses for household wear. They are pretty, but they do not last.

After all is said, the brick pavement is the dependable pavement. It is like a well-made, all-wool suit of clothing—for general utility it outlasts everything else and it retains its shape and good appearance while it does last.

A shoddy suit or a shoddy pavement is the most expensive of all pavements. It frequently needs patching and it has to be discarded very

Main Street, Battle Creek, Mich. (paved in 1897) with Metropolitan Paving Brick, ***has withstood*** the heavy poundings of traffic for twenty-one years and it is still in good condition. (Ask the other fellows to show you a street like this.)

Metropolitan (Canton, Ohio) Shale is the ***standard*** by which all other paving brick materials are judged. The Earth yields no other substance so appropriate for paving purposes! Its ***permanent*** quality—its ***freedom*** from imperfections—its ability to ***resist*** the action of time and weather make Metropolitan the ***"Best Paving Block Made."***

REPRESSED AND WIRE-CUT LUG

THE

Metropolitan Paving Brick Co.

"The World's Largest"

CANTON, OHIO.

soon. It never is useful for general purposes. It is good only for a short time, and at that for only the commonest and least stressful purposes, in which holes and shabbiness are not objectionable.

Some communities object to brick because brick pavements at the start cost more than some other kinds. But long service reduces the ultimate cost. Every additional year of service rendered without incurring repair expense adds to the value and reduces the cost of a street or road pavement built of brick. The true measurement of value is length of service. The true standard of cost is the ultimate cost.

If a brick pavement has worn twenty-five years and during that period has cost nothing for repairs and still is in good condition—and many brick pavements have such records—the pavement is pretty sure to last for a quarter century more.

A pavement which renders good service for twenty-five years or fifty years surely is worth much more than a pavement which will at most last but ten years or fifteen years and require almost constant attention every year during its life.

Many persons do not understand this, and others, who are obsessed by the idea that money spent for good roads is extravagance, ignore the facts because the facts militate against the mistaken idea of economy.

Moreover, a vitrified brick pavement properly laid according to modern specifications is practically noiseless. It does not rumble or reverberate under traffic; it originates no dirt or dust, and it is the most easily cleaned of all pavements.

Consideration of the foregoing puts out of court the contention of the penny-wise advocates of cheap construction.

Clinton Wire-Cut Lug

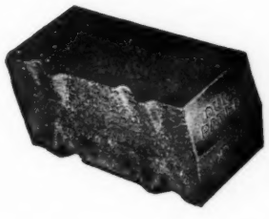
Meets *all* traffic conditions!

Clinton Vitrified Shale is uniformly high grade—it has been "proven best" in years of service!

Clinton Paving Brick Co.

CLINTON, INDIANA

Springfield Wire-Cut Lug



IS WIDELY USED

The square edges *stay* square, due to the spacing lugs and beveled ends. Both Dunn Wire-Cut Lug and Frost Process. Sewer and Building Brick—also very artistic Rug Face Brick.

Springfield Paving Brick Co.

SPRINGFIELD, ILLINOIS

MEDAL BLOCK
"The Block with Experience behind it"
BUYING cheap goods to save money, is like stopping the clock to save time; and this applies to many types of road surfacing material. If you want the only sure, durable and reliable road surface, buy
MEDAL BLOCK
"The Block with experience behind it"
Manufacturers of Medal Block for 23 years.
Manufacturers of Paving Brick for 29 years.
Oldest in service unexcelled in quality.
Medal Repressed, Wire-Cut-Lug and Hillside Block.
23 YEARS SERVICE
Capacity 55,000,000 annually.
THE MEDAL PAVING BRICK COMPANY
FORMERLY THE DECKMAN-DUTY BRICK CO.
1305-1308 Swetland Building
Cleveland, Ohio

Wire-Cut Lug Brick, Cement-Sand Construction, Require Less Foundation Depth

On Account of Great Bonding Strength and Durability, Wire-Cut Lug paving brick have greater beam strength inch for inch, than any other pavement.

Laid in one inch of cement-sand mortar, Wire-Cut Lug Brick require less depth of artificial foundation than other surfacing materials. The rigid beam has great load-bearing strength, while Wire-Cut Lug Brick offer unequalled resistance to the abrasive action of traffic.

For city streets this is the type of pavement which endures. It saves unnecessary excavation and economizes in materials for foundations, without endangering the strength and durability of the pavement.

Wire-Cut Lug Brick can be used to better advantage than other brick with soft fillers. The best results obtainable with any kind of filler are assured with Wire-Cut Lug Brick.

Wire-Cut Lug Brick are made by 48 independent, competing companies, operating 72 plants in 12 States.

—LICENSEES—

Corry Brick and Tile Co., Corry, Pa.
United Brick Co., Greensburg, Pa.
Sterling Brick Co., Olean, N. Y.
Danville Brick Co., Danville, Ill.
Clinton Paving Brick Co., Clinton, Ind.
Alton Brick Co., Alton, Ill.
The Medal Paving Brick Co., Cleveland, Ohio.
Metropolitan Paving Brick Co., Canton, Ohio.
Peebles Paving Brick Co., Portsmouth, Ohio.
Murphysboro Pav. Brick Co., Murphysboro, Ill.
Southern Clay Mfg. Co., Chattanooga, Tenn.
McAvoy Vitrified Brick Co., Philadelphia, Pa.
Windsor Brick Co., Akron, Ohio,
Hocking Valley Brick Co., Columbus, Ohio.
Veedersburg Paver Co., Veedersburg, Ind.
Springfield Paving Brick Co., Springfield, Ill.

Terre Haute Vitrified Brick Co., Terre Haute, Ind.
Albion Vitrified Brick Co., Albion, Ill.
Alliance Clay Product Co., Alliance, Ohio.
Westport Paving Brick Co., Baltimore, Md.
Mack Mfg. Co., New Cumberland, W. Va.
Hydraulic-Press Brick Co., St. Louis, Mo.
Barr Clay Company, Streator, Ill.
Burton-Townsend Co., Zanesville, O.
Trimble Paving Brick Co., Dayton, Ohio.
Thornton Fire Brick Co., Clarksburg, W. Va.
Indiana Paving Brick & Block Co., Brazil, Ind.
Standard Brick Co., Crawfordsville, Ind.
Shawmut Paving Brick Works, Shawmut, Pa.
Pennsylvania Clay Co., Pittsburgh, Pa.
Clydesdale Brick & Stone Co., Pittsburgh, Pa.
The John Kline Brick Co., Wickliffe, Ohio.

Streator Clay Manufacturing Co., Streator, Ill.
Martinsville Brick Co., Martinsville, Ind.
Cleveland Brick & Clay Co., Cleveland, Ohio.
Jamestown Shale Pav. Brick Co., Jamestown, N.Y.
Purington Paving Brick Co., Galesburg, Ill.
Georgia Vitrified Brick & Clay Co., Augusta, Ga.
F. R. Carter, Peoria, Ill.
C. P. Mayer Brick Co., Bridgeville, Pa.
Athens Brick Co., Athens, Ohio.
Albion Shale Brick Co., Albion, Ill.
Copeland-Inglis Shale Brick Co., Birmingham, Ala.
Brick, Terra Cotta and Tile Co; Corning, N. Y.
Medora Shale Brick Co., Medora, Ind.
Binghamton Brick Co., Inc., Binghamton, N. Y.
Municipal Shale Br'k & Bl'k Co., Martinsb'g, W.Va.
Lake Shore Shale Brick Co., Ashtabula, Ohio.

Write for data.

THE DUNN WIRE-CUT LUG BRICK CO., Conneaut, Ohio.

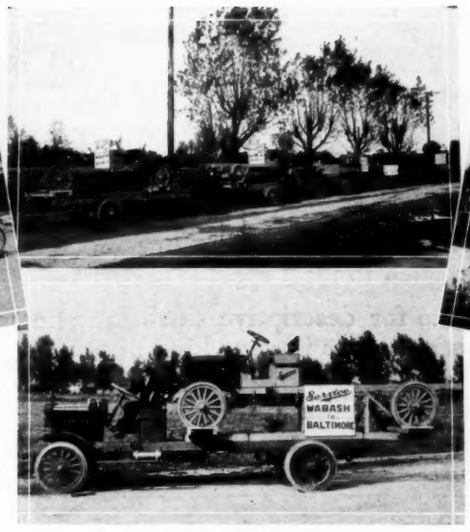
(LICENSORS)

MOTOR TRUCKS

Motor Trucks as Operated in the Intercity and Interstate Haulage of Freight on the Highways.

(FIRST INSTALLMENT)

WABASH TO YOUNGSTOWN.

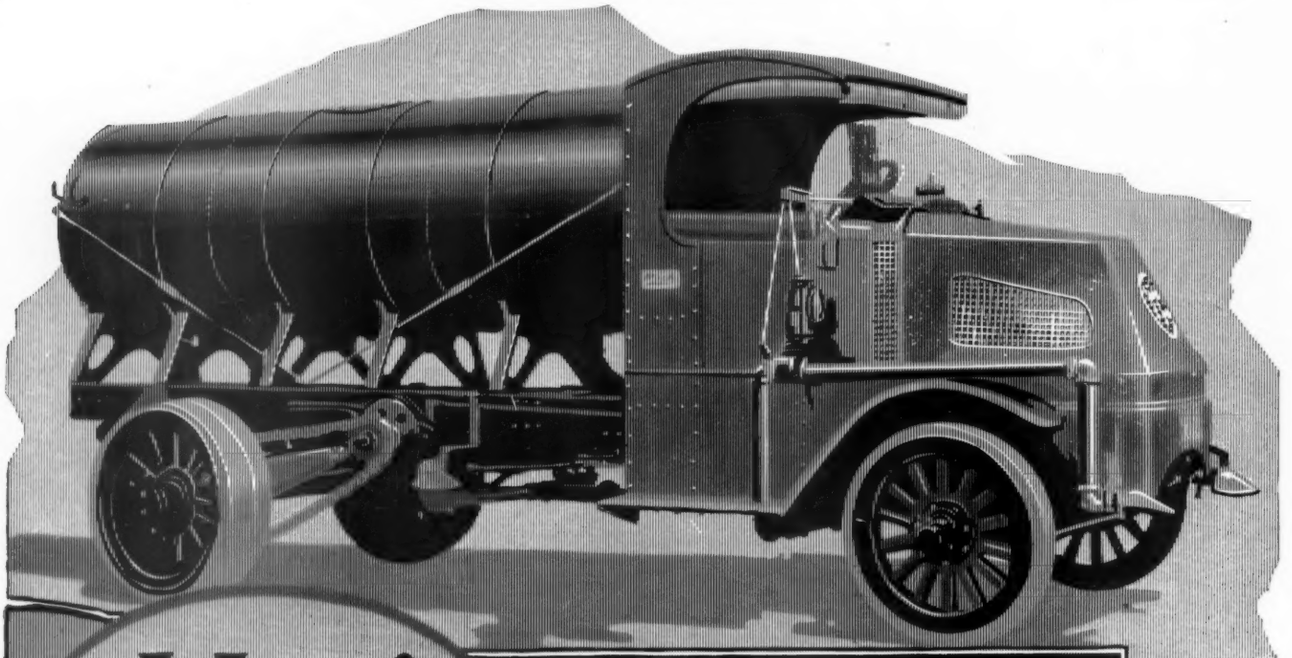


WABASH TO MILWAUKEE.

UPPER—WABASH TO NEW YORK CITY. LOWER—WABASH TO BALTIMORE.

Thousand-mile Cross-Country Haulage with Service Motor Trucks Is Now Quite Common, as These Views Show. Almost Every Day Trucks Leave Wabash, Ind., on Trips Ranging from 10 or 100 to 1,000 Miles Long. Record Runs Have Been Made at a Saving of Time and Money Over Railroad Haulage. Five Days to New York, Sixty-six Hours to Baltimore, a Day to Chicago, and a Day to Indianapolis Make Overland Motor Freight Haulage by Motor Truck Worth While.

Printed as insert to Municipal Engineering, February, 1918.



Mack TRUCKS

MACK Promotes City Cleanness

In their civic housekeeping, the Philadelphians of today carry out the traditional neatness of the Colonial Quakers.

The MACK flusher and sprinkler shown above cools the Philadelphia streets during the warm summer days. At night it serves as a flusher. It works 24 hours a day promoting civic sanitation and comfort.

This MACK is one of 7000 on duty in all kinds of work throughout the world. For twenty years MACK trucks have demonstrated their power and reliability.

The MACK is made in sizes from 1 to 7½ tons capacity; with trailers, up to 15 tons capacity. Bodies can be designed to meet specific needs.

Write for descriptive catalogue and record of MACK performances in your kind of work.

INTERNATIONAL MOTOR COMPANY
NEW YORK

Performance Counts

Transportation
is the foundation
of Progress

WITHOUT transportation we cannot have production; labor would be helpless.

Without transportation we cannot gather raw materials or develop unfinished products.

Without transportation we would practically stand still in economic and social development.

Transportation is one of the most important factors in building up any country.

Today it is of still greater importance to the U. S. and the Allies in the winning of the war in which we are now engaged.

The public highway must take its place in our great system of transportation, and to accomplish this we must build and maintain highways to meet traffic requirements.

Address Department 107.

Garford MOTOR TRUCKS

The Garford Motor Truck Company, Lima, Ohio

Manufacturers of Motor Trucks of 1, 1½, 2, 3½ 5 and 6 ton capacity. 4½, 7 and 10 ton Tractors
The Garford Road Builder

GMC
TRUCKS

GMC Trucks Practical on any Job—

DOING city department work with trucks demands peculiar staunchness of construction. Particularly is this true with respect to street flushing.

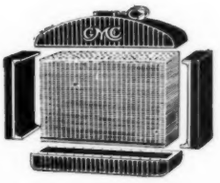
The side-wash and end-flow of water in the big tank demand flexibility in motor and chassis. Exposure to moisture, both through weather conditions and street flushing, demands resistance to metal deterioration.

GMC Trucks meet all these conditions, and are today doing department duty in thousands of cities.

Made in a factory where truck building has been the exclusive work since the beginning of the industry, GMC Trucks long ago passed the stage of experiment.

Street cleaning work is but one of the hundreds of variations in the duty-ability of GMC Trucks.

Write Truck Headquarters for the right truck for your business. Made in six practical chassis sizes.



The Radiator

Proper cooling means highest engine efficiency. Many factors must be taken into account. They are:

Radiation surface—water and air circulation—strength of materials—solidity of assembly and mounting.

The GMC radiator is the continuous fin type, vertical brass tubes. Water is forced. A four-bladed fan forces air circulation.

The GMC radiator is adapted to all climates and altitudes.

GENERAL MOTORS TRUCK COMPANY
One of the Units of the General Motors Corporation
New York Philadelphia Boston PONTIAC, MICH. Chicago St. Louis San Francisco
Distributors most Everywhere
(300)

MOTOR TRUCK OPERATION AND ACCOUNTING XXX.

By Charles A. Dickens

Since the United States entered the war motor truck transportation on country highways has rapidly developed. This rapid development, as analyzed by Arthur H. Blanchard, consulting highway engineer, New York City, is due to the following causes:

First, the marked increase in the tonnage and bulk of shipments; second, the lack of railroad equipment to handle freight and express transportation efficiently; third, the inadequacy of railroad terminal facilities; fourth, the United States Government priority orders; and fifth, the intensified consideration of economic problems, the solution of which would lower prices of the necessities of life. "Due to the foregoing conditions," says Mr. Blanchard, "transportation by motor trucks is developing along the following lines:

Lines Along Which Motor Truck Transportation Is Developing

"Available cost and operation records and the opinions of users of motor trucks on long hauls leads to the conclusion that, granted good roads and efficient management, the transportation of industrial and agricultural products on hauls of 50 to 75 miles is economical under peace as well as war conditions. Recent evidence in support of this contention is furnished by statements of motor truck companies using country highways. Motor truck transportation for distances in excess of 75 miles will be found to be economical under certain conditions. Under war conditions excessive long haul transportation will be developed to a large extent.

Establishment of Express Motor Truck Transportation

"Incident to the general development noted, is the progressive establishment of express motor truck transportation companies, several of the pioneers being in operation in the State of New York four or five years ago. One of the best known companies is operated by the Goodyear Tire and Rubber Company between Akron, O., and Boston, the round trip of 1,510 miles being made in less than one week. Another prominent company, the Beam-Fletcher Corporation, operates a daily motor truck service between Philadelphia and New York, and guarantees deliveries in New York by noon of goods received not later than 5 p. m. on the preceding day in Philadelphia.

"Another special field in which motor truck transportation is developing is found in areas surrounding railroad centers. Under peace and war conditions it is economical, granting good cross-country highways and efficient management of motor truck companies, to transport freight consigned to a town on one railway line entering the terminus from a town located on another radiating railroad. Under war conditions, at least, the railroads will welcome such development of motor truck transportation, as freight cars are thus saved for long hauls and the congestion of freight yards relieved.

"Under war conditions railroad freight haulage by motor trucks over highways paralleling railways may, in some cases, become mandatory in order to relieve the congestion of terminals and increase the monthly ton mileage of freight cars. By increasing unloading facilities at railroad stations on lines entering a city, many classes of freight consigned to the terminus could be transferred to motor trucks and thus delivered to the consignees.

"If the food problem is partially solved by the establishment of city public markets supplied by motor trucks direct from farms, motor truck traffic will increase enormously on many highways entering cities. In Congress there is already under consideration a bill to establish postal motor truck routes on which farm produce would be collected for delivery, not to retailers, but direct to city homes."

VIEWS OF THE AKRON (OHIO)-BOSTON (MASS.) MOTOR TRUCK LINE AS OPERATED ON REGULAR SCHEDULE. LEFT TO RIGHT: ON A LONG GRADE JUST EAST OF WILMERDING, PA.—STUCK IN THE MUD.—NEARING SUMMIT OF THE 4-MILE GRADE NEAR LIGONIER, PA.—EN ROUTE EAST OF GREENSBURG, PA.

Service OK'd by the City of Chicago

Service 5-ton Trucks! Seven of them! Were ordered by the City of Chicago! Thirteen big truck makers (including the "Dominant Ten") were asked to furnish specifications. On a basis of sheer efficiency each and every make was subjected to a rigid and accurate test. It was a clean-cut race.

Here are the merit marks scored by Service Motor Trucks and its competitors

SERVICE MOTOR TRUCKS	91.37
No. 1 Competitor	89.29
No. 2 Competitor	88.06
No. 3 Competitor	85.47
No. 4 Competitor	85.41
No. 5 Competitor	84.37
No. 6 Competitor	82.93
No. 7 Competitor	81.23
No. 8 Competitor	80.91
No. 9 Competitor	78.47
No. 10 Competitor	77.44
No. 11 Competitor	74.31
No. 12 Competitor	71.26

Following is the efficiency basis of selection

Price	4
Chicago service facilities	10
Inspection or testing of parts and material	6
Number of trucks of type specified in service	4
Number of years manufacturer has been engaged in truck construction	4
Manufacturer's responsibility	6
Chicago dealer's responsibility	4
Comparative cost of repair parts	2

Design and Construction

General design	4
Accessibility	5
Motor	12
Clutch	5
Transmission gear set	6
Final drive and axles	12
Frames	5
Springs	2

FROM 2 TO 20 POINTS WERE SCORED BY SERVICE OVER ITS CLOSEST AND furthest competitors. The engineers of the City of Chicago convinced themselves of the supremacy of SERVICE trucks on every phase of construction, durability, reliability and service. Take the mechanical features—with a total of 60 points. Here the highly specialized motor—built for rigidity—high operating flexibility—trouble free lubrication under all conditions of driving and load, gave Service Motor Trucks a big lead. In the final drive—Service strength—quiet, efficient transmission of power through worm and gear construction—re-enforced to take care of the unusual conditions of operation led among competitors.

The same balance of points in favor of Service design won in the examination for accessibility—braking safety—strength of frame. Service 20 per cent. superior strength in every part gave first rank for long, trouble-free operation. 20 points were determined on a straight responsibility basis—manufacturers' reputation—record of trucks in operation, and here Service Motor Trucks with 7 years of satisfactory dealing with owners again gave a big percentage of superiority. These are the points which should determine your own selection.

SERVICE MOTOR TRUCK CO.

WABASH, INDIANA

DUPLEX 3½-TON TRUCK HAULING GRAVEL, TOOLS, BUNKHOUSE, TANK WAGON, CONCRETE MIXER, WAGON AND 8 MEN.

DUPLEX 3½-TON TRUCK HAULING A 6-TON LOAD FROM DENVER TO COLORADO SPRINGS.

The Akron-Boston Truck Line

A review of motor truck transportation on the highways would not be complete without detailed mention of the experience of the Goodyear Tire and Rubber Company, Akron, Ohio, in operating a fleet of four trucks in freight transportation between Akron and Boston. This line has been in operation since March, 1917. Sometimes all the trucks are on the Boston run; at other times, according to the demand, they are in operation between Washington, D. C., Cleveland, Dayton and Akron. The fleet at first consisted of a 1½, a 3 and two 5-ton trucks. Two more trucks will be added at once, it is reported, a 3 and a 5-ton machine. During the first eight months this line was in operation there was an average delay of only four hours in every 24 for stops of all kinds, including meals, accidents, loading and unloading.

Time Schedule Between Akron and Boston

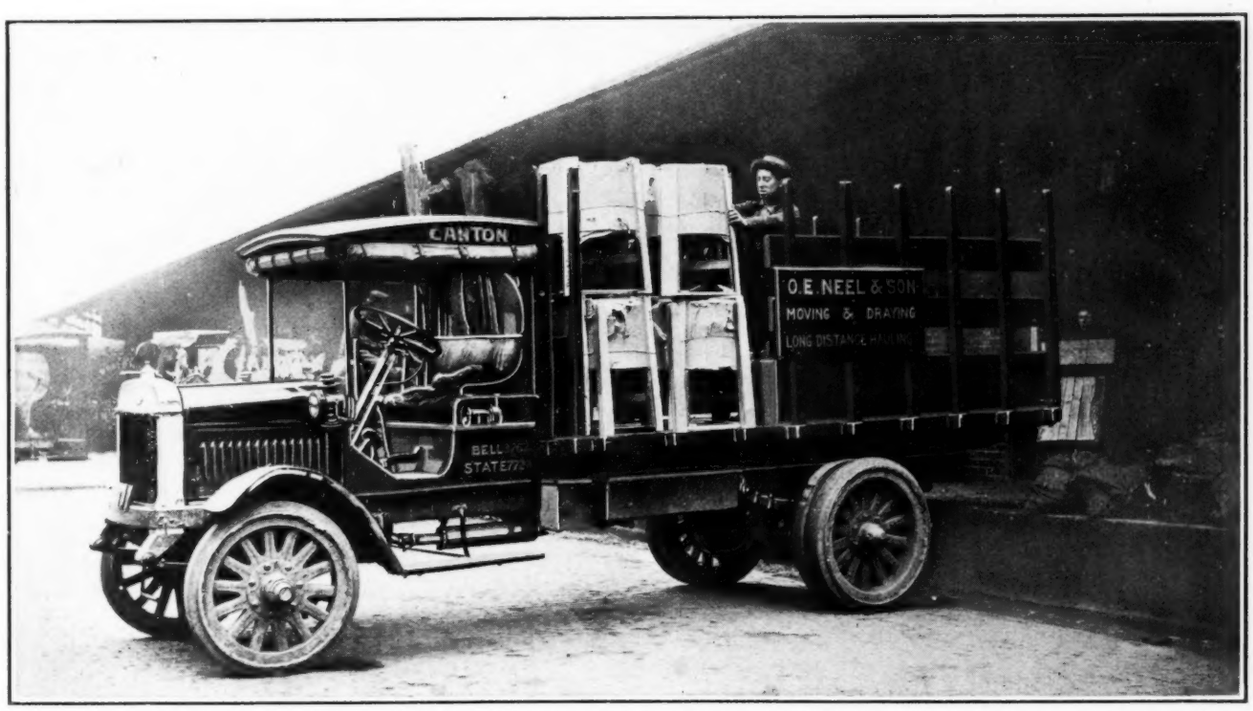
AKRON TO BOSTON

City	—TIME— Arrive	Leave	Miles
Akron	.....	6:00 a.m.	...
Beaver Falls	3:00 p.m.	3:30 p.m.	90
Pittsburgh, Pa.	6:30 p.m.	7:00 p.m.	120
Greensburg, Pa.	11:30 p.m.	12:00 p.m.	151
Bedford, Pa.	10:30 a.m.	10:45 a.m.	216
Chambersburg, Pa.	7:00 p.m.	7:30 p.m.	270
Gettysburg, Pa.	10:45 p.m.	10:45 a.m.	300
Lancaster, Pa.	5:00 a.m.	5:30 a.m.	356
Philadelphia, Pa.	11:30 a.m.	12:00 a.m.	404
Trenton, N. J.	3:30 p.m.	4:00 p.m.	443
New York, N. Y.	10:00 p.m.	.....	504
Bridgeport, Conn.	3:30 a.m.	4:00 a.m.	560
Hartford, Conn.	9:00 a.m.	.....	617
Springfield, Mass.	1:00 p.m.	1:30 p.m.	643
Worcester, Mass.	6:00 p.m.	6:30 p.m.	700
Boston, Mass.	10:00 p.m.	.....	740

The Akron-Boston line has amply and conspicuously demonstrated the commercial feasibility of interstate motor truck haulage over the highways.

The average operating speed for the round trip is 10 miles an hour. Through the mountains the average is reduced to 6 miles an hour; eastward the mean rate of speed is about 15 miles an hour. The uncertain average lies between Akron and Pittsburgh through the 20 miles of mud road. It is here that most of the delays occur and where the average speed is reduced to nearer 8 miles an hour. A truck was mired here for 6½ hours on one trip.

These speeds are for the 5-ton trucks. Each trip schedule is reduced 4 hours for a 3-ton truck, and on one run the driver



GRAMM-BERNSTEIN 3½-TON TRUCK AS OPERATED IN INTERCITY FREIGHT SERVICE BY O. E. NEEL & SON, CANTON, OHIO, BETWEEN YOUNGSTOWN, AKRON, CANTON AND CLEVELAND.

"In Gramm-Bernstein Motor Trucks there are *No* Transmission Losses between the source of power and the work to be done," —that's how a leading Chicago contractor puts it.

Most truck diseases are traceable to ***faulty*** transmissions! And if such an Epidemic is prevalent in your fleet, you can count on one thing, and that is—they are ***not*** Gramm-Bernstein Motor Trucks.

The Gramm-Bernstein Transmission is not only trouble-proof, but it is Fool-Proof. There is no stripping of gears because the teeth are never out of proper contact, and there is no shifting of gears because the gears are always in mesh. And the ***Control is simple and sure***—positively Error-Proof. The interlocking device (which absolutely prevents shifting more than one speed at a time) requires that ***All Speeds*** be in neutral position before the shifting of any speed can be accomplished.

These are just ***two*** reasons why your investment in **Gramm-Bernstein** Trucks is protected against the carelessness of your regular drivers or the inexperience of "green" men. If you're interested in this form of Trouble-Insurance, you're interested in **Gramm-Bernstein** Trucks because this form of transmission can be had on none other. Remember there are ***just two kinds*** of trucks, the **Gramm-Bernstein** and others!

The Gramm-Bernstein Motor Truck Co.

LIMA, OHIO.

TRAIN OF 30 PACKARD TRUCKS EN ROUTE FROM DETROIT TO BALTIMORE, LOADED WITH WAR MUNITIONS MADE IN DETROIT. TRAIN NEGOTIATED 580 MILES IN TWO WEEKS.

brought his machine in 4 hours ahead of his schedule, making the round trip in 6 days.

Good Roads of Eastern States Aid Motor Truck Haulage

Gasoline motor trucks are much used for long freight hauls. "Today," writes Mr. Walker, of the Hurlburt Motor Truck Company, "they are sending motor trucks over the roads between New York and Philadelphia and New York and Boston. In most cases these trucks start out and the drivers are relieved at certain points and take up one of the returning trucks, so that they only have to work a full eight hours—that is, on the Philadelphia route a man starts out from New York with a truck fully loaded for Philadelphia. He awaits, or rather meets, in Trenton, the truck coming up from Philadelphia. He takes this truck and drives it back to New York, while the driver from Philadelphia drives the New York truck on to Philadelphia.

"There has been great agitation to put trailers on trucks for these long-distance hauls, but so far this has not been found satisfactory, as these additional loads greatly overtax the motor. I would advise that the 3½-ton and 5-ton trucks are the best suited for these purposes, as they carry gross loads at a minimum of expense. There is no doubt about the fact that the railroads are seriously handicapped and that a great many of our present shortages in materials and foodstuffs would be relieved if the motor trucks took care of the short-distance freight hauls. How practical this plan is in the West is another story, but in the New England and Eastern States the roads between the big cities are in such perfect condition that this motor travel could be maintained throughout the year."

Intercity Hauling Between Ohio and Pennsylvania Cities

O. E. Neel & Sons, of Canton, O., are operating 3½-ton Gramm-Bernstein trucks principally for intercity hauling between Youngstown, Akron, Canton and Cleveland. The truck has performed remarkable service at an exceptionally low maintenance cost, and is easily proving the statements and claims that the motor truck can and will be very rapidly used to economic advantage in relieving the congested conditions existing in the freight departments of the railroad and express companies. At the present time between the above-named cities there are something like 45 or 50 Gramm-Bernstein motor trucks being used daily.

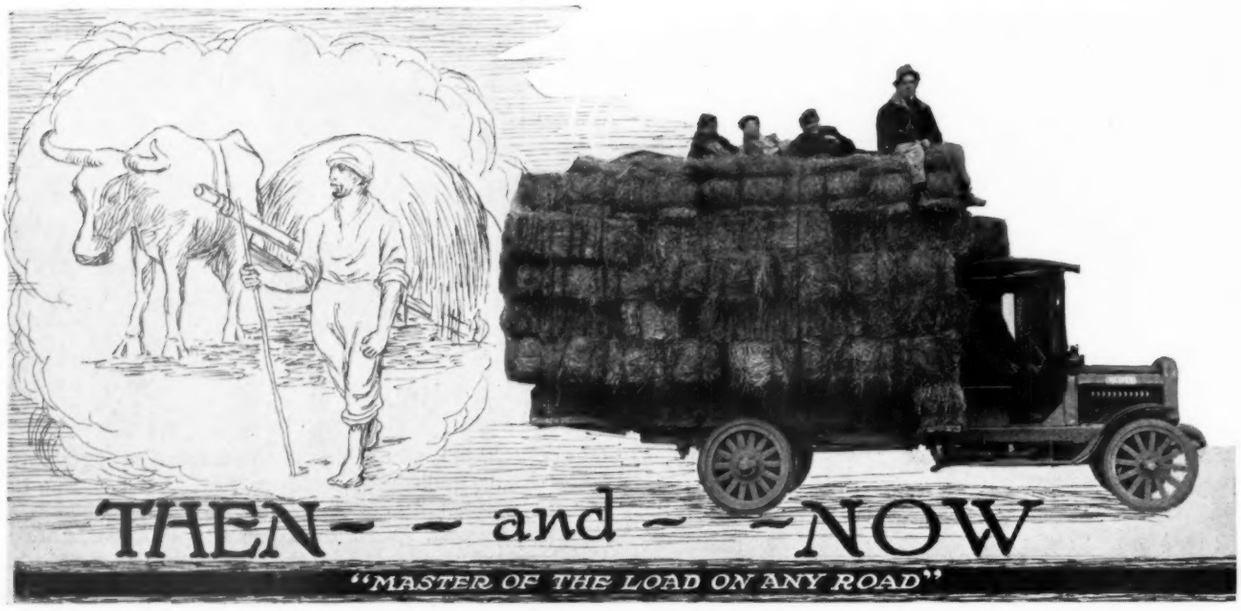
A short time ago the East Palestine Rubber Company decided that they wanted to move their stock and equipment and fixtures from their Pittsburg quarters to East Palestine, O., where their new plant is located. The distance is 85 miles. The matter of shipping by freight was entirely out of the question, as not even an estimate was made by the railway freight people as to when delivery even this short distance could be expected.

Next, recourse was had with the express companies, and, while a high rate prevailed, this was waived by the East Palestine Rubber Company, but they found the time of delivery was equally as uncertain with them as with the freight company.

Five large 5-ton Gramm-Bernstein motor trucks belonging to the Douglas Transfer Company were pressed into service and loaded to their capacities and started for East Palestine over very poor roads and with extremely bad weather. Almost 18 miles of the distance between Pittsburgh and East Palestine had to be made over the very worst kind of roads, requiring the drivers to operate their trucks upon first speed.

Notwithstanding the above conditions, the trucks made the trip successfully, never being held up for one minute in a run-

MASTER 6-TON TRACTOR AS OPERATED IN THE INTERCITY HAULAGE OF FREIGHT.



MASTER TRUCKS

Are everywhere Relieving Traffic Congestion.

They are rushing raw materials to the factory—and the finished product to the buyer. They are speeding up the intercity and interstate haulage of freight.

Your transportation facilities of yesterday may have been as efficient as conditions demanded. But conditions have changed. Haphazard, slow methods belong to the past, not to the present. Today, your haulage requirements are best met by the truck which has proven itself "Master of the Load on *any* Road."

The famous **Master** 2-ton truck, light, strong and powerful, with its Special Master H U Buda Military Motor, sells for only $2190—Master 3½-ton, $3590 (worm)—$3390 (internal gear)—Master Tractor, $2450. Write in today for full information concerning the exclusive Master Hydraulic Hoist and Dump Body, and the special body designs for every purpose.

Each and every **Master** part is not only oversize, but is most carefully constructed from only the highest quality materials obtainable. **Master** Trucks are not makeshift contraptions. They "stand up" and "deliver."

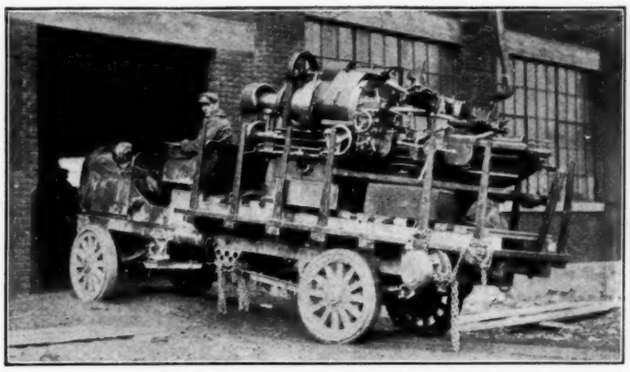
PROMPT DELIVERIES GUARANTEED.

Above all else, deal now with a dependable company making trucks alone, and equipped to fill your orders and re-orders on time. Sell the powerful, reliable **Master**—the final result of fifteen years of engineering knowledge and experience. Don't disappoint your trade now. They will come to you for rush orders on dependable **Master** Trucks. Get posted on the special **Master** proposition waiting for you. Write today.

MASTER TRUCKS, Inc.

3145 Wabash Avenue. **CHICAGO, ILL.**

SERVICE 5-TON TRUCK AS OPERATED IN FREIGHT HAULAGE BETWEEN CHICAGO AND DETROIT.



DUPLEX TRUCK HAULING MACHINERY FROM DUPLEX FACTORY, CHARLOTTE, TO LANSING, MICH.

ning time of a little over 11 hours, returning to Pittsburgh the next morning, proving conclusively that the motor truck has solved a very perplexing problem now confronting all transportation companies.

First U. S. Army Truck Train from Detroit to Atlantic Seaboard

During the fortnight between December 14 and December 28, 1917, the first United States Army truck train to go overland from Detroit to the Atlantic seaboard was en route. It was a train of 30 Packard trucks. Almost to the hour, two weeks after it left the Packard factory in Detroit, it pulled into Baltimore at the end of a run of 580 miles.

The trip was made at the instance of the Highways Transportation Committee of the Council of National Defense and the Quartermaster Department of the United States Army. Captain Bronson commanded the convoy, Lieutenant Riley the train. The personnel was made up of 79 enlisted men, drivers, mechanics, cooks, from Camp Sherman, at Chillicothe, and from Marfa, Tex. Two tank trucks and a kitchen truck were in the train. The war trucks were loaded with munitions made in Detroit.

No effort was made to establish a time record. That was not the purpose of the trip. The run was made to establish first whether the general idea of transporting trucks and capacity loads of munitions was sound. Neither the preparations for the trip nor the manning of the trucks permitted any attempt at an extra fast schedule. And still the train made good running time all the way.

Using Trucks in Long-Distance Transfer Hauling

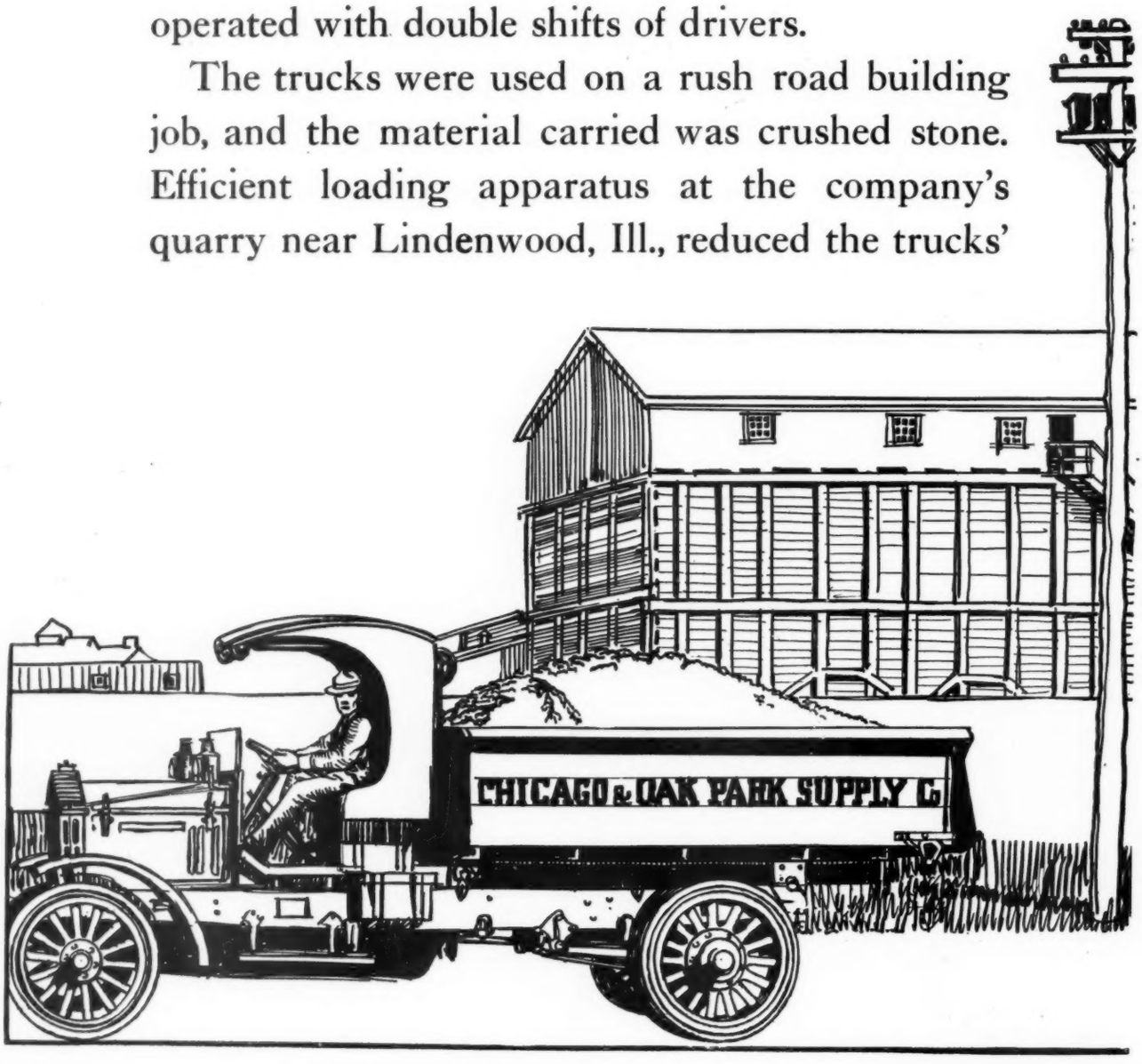
J. F. Reilly, of Easton, Pa., operates a Federal truck in the transfer and general hauling business. This truck has been taken through to Sixty-eighth street, Brooklyn, to Harrison, N. J., and to New York City proper. One of his trips was made from Easton to Shamokin, Pa., a round trip of 219 miles. The route led through the great mining district of the Pennsylvania mountains. Some fine roads were encountered, but much of the road was rough and mountainous. He left Easton with the truck at 6 a. m., June 11, and arrived in Shamokin at 6:30 p. m. The load—four rooms of furniture—was put on that night and at 7:30 the next morning he left Shamokin. Easton was reached that night at 10:30. Much time was saved over the best service at the time available from the railroads. The truck consumed 30 gals. of gasoline, an average of 7 miles per gallon.

GENERAL MOTORS ¾-TON CHASSIS AS OPERATED BY THE HAGEMAN TRANSFER CO., SHELBY, OHIO, IN HAULING HOUSEHOLD GOODS. THE "TRAILER" WAS FORMERLY HORSE-DRAWN.

These
PIERCE-ARROW TRUCKS
averaged 156 miles a day on road construction work

THE Chicago and Oak Park Supply Company works all of its four 5-ton Pierce-Arrow trucks hard, but it set a record recently by getting 156 miles daily out of two of the trucks that were operated with double shifts of drivers.

The trucks were used on a rush road building job, and the material carried was crushed stone. Efficient loading apparatus at the company's quarry near Lindenwood, Ill., reduced the trucks'



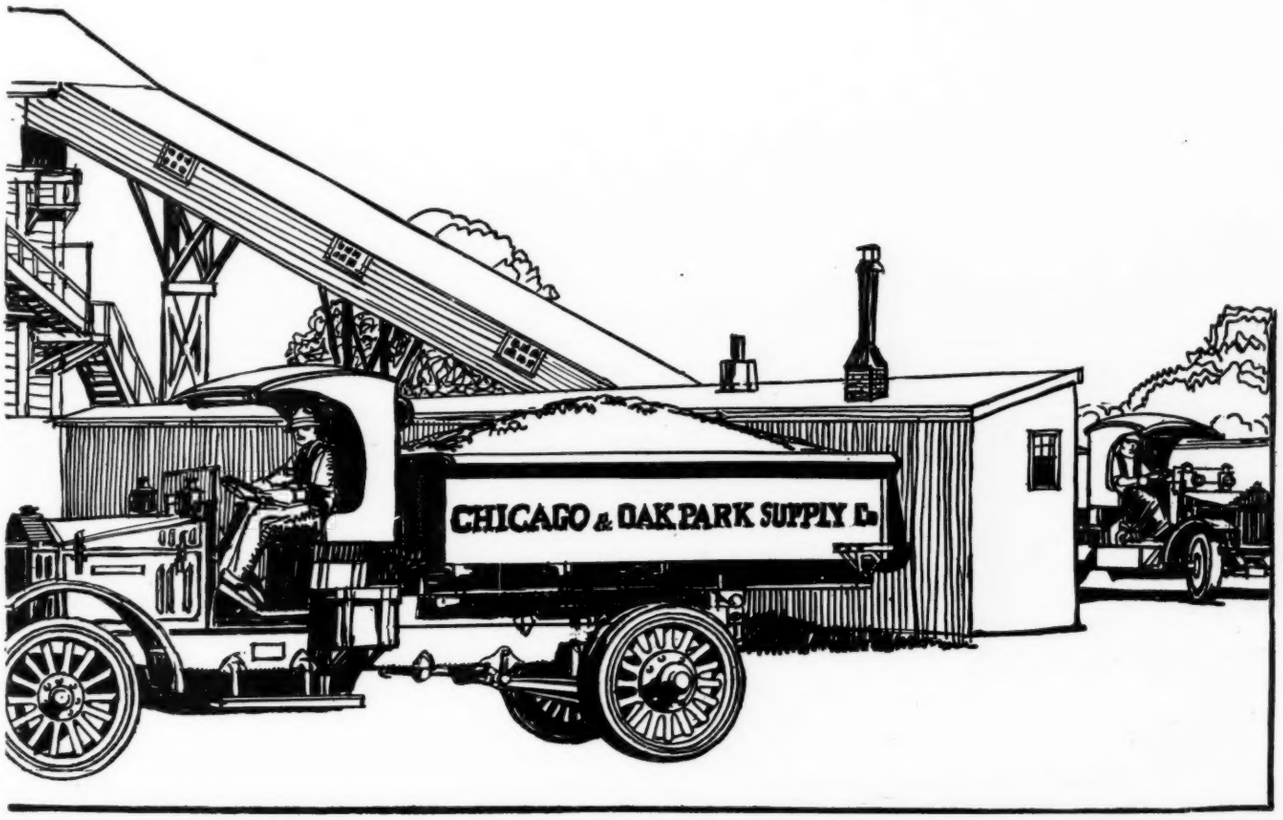
idle time to a minimum. Loading and unloading took less than a minute at each end.

The company has found that each of its Pierce-Arrow trucks replaces four teams and does the work more satisfactorily. The trucks are used on various kinds of construction work and for hauling heavy materials such as sand and stone. It is seldom that any of the trucks average less than fifty miles a day.

A number of other interesting installations are shown in our booklet "What Pierce-Arrow Trucks Are Doing in the Contracting Business." We shall be glad to send you a copy.

THE PIERCE-ARROW MOTOR CAR CO.
BUFFALO, N. Y.

The Worm-Gear
All Pierce-Arrow Trucks are equipped with the worm-gear drive, which is a positive guarantee of effective service under the most difficult conditions.



U S
FLOATING POWER PLANT
MOTOR TRUCKS

Unusual Loads Unusual Distances

Machinery, forgings, riggers and builders tools make up the loads hauled by the 3½ ton U. S. truck operated by Holroyd Brothers, 621 Brooklyn Street, Philadelphia.

Loads are of unusual shape and when a trailer is used weigh up to 10 tons. Trips range from 10 to 300 miles.

Recently the truck hauled 4 tons of riggers tools and pulled 5 tons of timber on a two-wheeled trailer—through the congested traffic of Philadelphia and for 30 miles over country roads.

In this service the average cost of U. S. truck operation per day and per mile has been found to be exceptionally low.

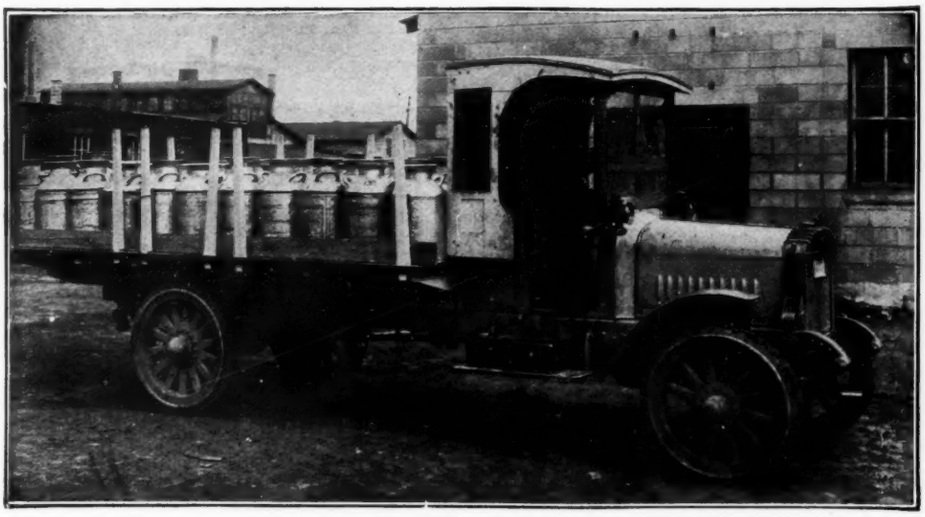
It moves tools and equipment much more promptly and reliably than can be done by railroad under present conditions.

Worm-Drive—2½, 3½ and 5-ton.
Chain-Drive—2½ ond 3½-ton.

The United States Motor Truck Company Cincinnati, Ohio.

New York Philadelphia Baltimore Pittsburgh
Cleveland Denver Detroit Chicago Atlanta
St. Louis Boston Minneapolis

Dealers in all Commercial Centers.



MASTER TRUCK AS OPERATED BY ALLEN MILK CO., BELOIT,. WIS., IN INTERCITY HAULAGE OF MILK.

Hauling Steel from Pittsburgh to New York

Steel is being hauled from Pittsburgh, Pa., to New York City by motor truck, not a few loads only as an emergency measure, but as a regular practice because of the freight congestion on that route. The material so carried is for the construction of the subways in New York, the completion of which has already been delayed five or six months by war conditions. Freight congestion was not the only condition causing delay, the federal government having taken for war purposes material completely fabricated for subway purposes and ready for shipment. It is a sign of the times that large quantities of steel can be brought by motor truck over this 450-mile route without prohibitive cost.

Shoe Company Uses Truck to Overcome Railway Congestion

The George E. Keith Shoe Company, manufacturers of the well-known Walkover shoe, use a Duplex truck to relieve freight congestion. Lumber for their shoe cases comes from a mill at Littleboro, Mass., which is about 25 miles from their factory at Campello. Formerly the Keith Company had to depend on the railroads to get the lumber from the saw mill to their receiving room, but lately "depending" on the railroads did not always result in shipments.

Their truck makes a round-trip a day from the mill to the factory, a distance of some 50 miles, with 4 tons of lumber and drawing 5 more tons on a trailer. The additional trailer load, the shoe people estimate, is practically as economical to handle as the truck load alone would be. The combination of Duplex and trailer has meant a great saving in freight costs for the Keith Shoe Company.

Cement Company Builds Concrete Road for Motor Haulage

The Universal Portland Cement Company recently completed 3,700 ft. of concrete road connecting its plant at Buffington, Ind., with Pennsylvania avenue, leading into Indiana Harbor, and also nearly 9,500 ft. of concrete pavement within its plant. This will permit shipping cement by motor truck from Buffington to Indiana Harbor, East Chicago, Gary, Hammond, Whiting and South Chicago. The industries of the Calumet district, many of which are working on government orders, will be supplied with cement, regardless of railroad conditions.

Use Motor Trucks for Parcel Post

Within two months the U. S. Postoffice Department's motor truck parcel post service will be extended, it was announced in Washington, early in January, to routes totaling between 3,000 and 4,000 miles. One chain will extend from Portland, Me., to New Orleans; one will cover a large stretch of territory in Ohio, Indiana, Illinois and West Virginia, and others will serve several California cities. Routes are already in operation in connecting Washington with Pennsylvania and Maryland.

The Postoffice Department believes that the new routes and others to be established later will aid materially in the distribution of parcel post matter and lower the cost of food products. Introduction of motor trucks on all star mail service

ACASON 5-TON SPECIAL DUMP BODY TRUCK THAT SOLVED THE HAULAGE PROBLEM FOR ONE BUILDER.

"EQUAL TO ANY OCCASION"

SCHACHT

WORM DRIVE TRUCKS

"Heavy Haulage is Cheap Haulage with our **Schacht,"** *writes a western contractor. "It averages 100 tons a day, and many of the hauls are long ones and over rough roads.*

"And it has more than paid its keep on short hauls. Our 5-ton **Schacht** nets us an average of $30.00 per day over horse haulage. Repairs during the last year almost nothing."

Such records prove the economy of **Schacht** Stamina. Super axles. Every strain bearing part of extra strength and dimension. That's why **"Schachts Stand the Strain,"** and its mighty power plant is in excess of all requirements—it works day-in-and-day-out with sound business-like hum that is good to hear.

Quick deliveries on 1½ to 2-ton, 2½-ton, 3½-ton or 5-ton models. We make **Schachts** ourselves—that's why we can guarantee *Quick Service.*

Some territories are yet open, and in these **Schachts** will sell quickly because they are Especially suited to contract work, and because we can fill orders immediately! ***Get details!***

THE G.A. SCHACHT MOTOR TRUCK COMPANY

CINCINNATI, OHIO, U.S.A.

EFFICIENT--ECONOMICAL--DURABLE

routes, where roads permit, is planned by the department under authority of a recent law permitting it to specify the type of vehicle used. The department has now power to compel the use of motor vehicles on the regular rural routes, but legislation will be sought to provide for government owned motors for parcel post deliveries in this service, too.

Interstate and Intercity Haulage with Packard Trucks

Packard trucks are rendering much assistance to the overburdened railroads. One example is the work of the Baltimore & Bellaire Auto Express Company, of Baltimore. This company operates a fleet of Packard trucks out of Baltimore to towns as far as 40 miles away, and is a transportation system in itself. The trucks carry pay loads both ways and have their regular freight stations in Baltimore and the smaller places which they serve. This truck line is operated side by side with the B. & O. and the Pennsylvania railroads.

(*To be continued in March number.*)

Dump Truck Powered with Wisconsin Motors

CONSISTENT

The standard power for municipal trucks

Write for specifications on different types and sizes.

WISCONSIN MOTOR MFG. CO.
Station A. Dept. 330
MILWAUKEE, WIS.
New York Branch,
21 Park Row,
T. M. FENNER, Factory Rep.

DUPLEX

THE ORIGINAL 4-WHEEL DRIVE TRUCK

SPEEDING UP THE NATION'S TRANSPORTATION
Duplex direct shipments reduce transportation costs and delays. They make possible the release of cars and locomotives needed for long hauls.
Built with a big margin of overstrength, Duplex trucks are giving dependable service for contractors, road builders, manufacturers, jobbers—business men in all fields of industry.
Let us send you Duplex haulage facts and figures for your particular business. Write for the heavy haulers magazine, "Duplex Doings."
Address all communications to Department 112.
DUPLEX TRUCK COMPANY
Lansing, Mich.

Acason
THE OWNER FIRST

Acason
THE OWNER FIRST TRUCKS

Government demand for heavy duty motor trucks will make it increasingly difficult for other buyers to get good trucks this year.

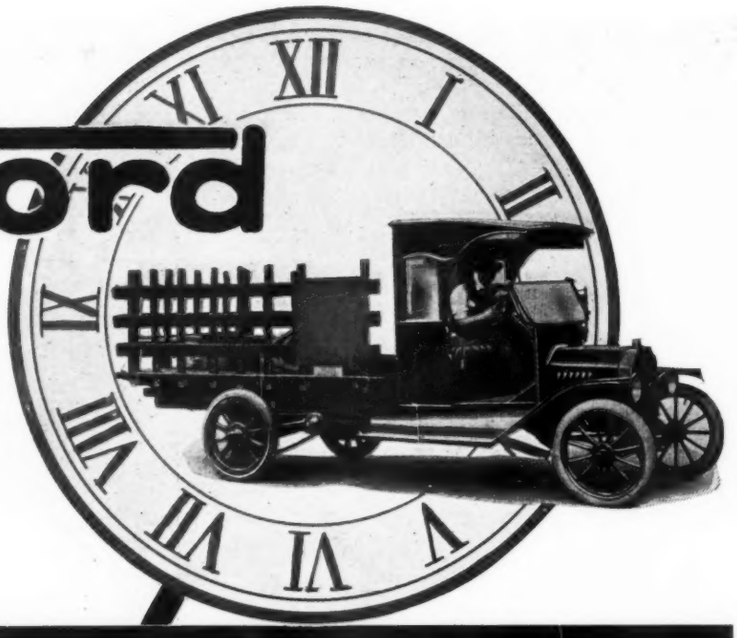
Orders placed *now* insure deliveries in time for the tremendously busy season just ahead.

Dealers in unoccupied territory are urged to get our proposition without delay.

ACASON MOTOR TRUCK CO.
DETROIT, U. S. A.

THE OWNER FIRST

Tonford



Any Time, *Any* Day, the **Tonford** more than pays its way! It is Always Ready (three hundred sixty-five days a year) to give *unequalled* service to its owner.

"OUR **Tonfords,"** states an Illinois contractor, "are *continually* busy carting tools and men from job to job as well as hauling light machinery and materials. They go *anywhere* and *everywhere* on the job—into places our heavy truck drivers would not venture.

"Full 90% of the Tonford load is carried on the rear axle, so there is no more strain on the Ford front axle than it was designed to carry as a touring car. No more 'tote-ing' of light loads in heavy trucks—it doesn't pay."

No injury to sprockets in striking road projections—no dragging of chains in the dirt! The **Tonford** Patented Split Flange Sprocket permits a 56-inch rear tread without large rear wheel sprockets. We'll send the illustrated particulars.

Detroit Truck Company

8th and Fort Sts. **DETROIT, MICH.**

Internal Gear Tonford . $390 . F. O. B. Detroit
Chain Drive Tonford . 350 . F. O. B. Detroit

Fortify Yourself! Against mishap by the ***super*** strength of HALL Chassis construction. *Stronger* Steering Knuckles and Axles! *Heavier* Extra Wide and *longer* flexible Springs. Every strain-bearing part is extra dimension! Brutally Strong! Yet Light-Footed in picking its way over Bumpy Roads, Grade-crossings and Cobble-stones. HALL "Safety-Margin" Super-Strength and Weight of materials and parts means Years of *unflinching* Performance "on the job." A HALL Truck is not subject to Nervous Spells and Break-downs. It's the Giant among trucks! "Solid as a Rock," says a big contractor, "and no trouble of any kind at any time." Haul it in a HALL.

When accidents happen, it is too late to find out what broke first. HALL Stability spells Safety. There is no other truck as strong as the HALL Truck. And there is a HALL Truck for every haulage requirement.

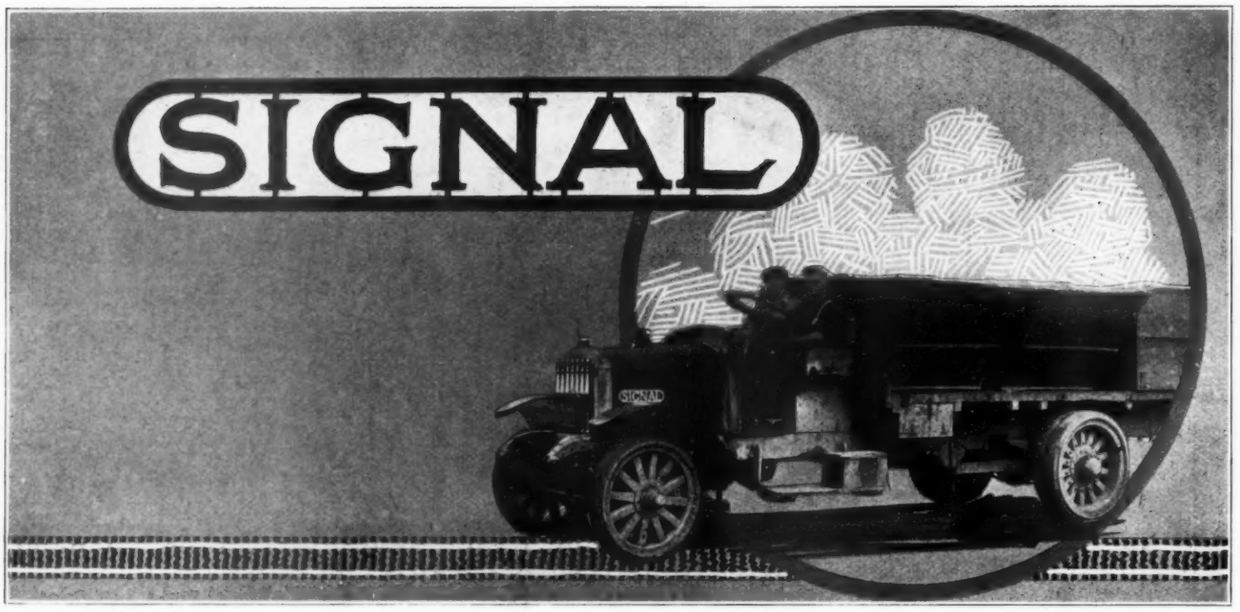
THE LEWIS-HALL IRON WORKS

Manufacturers of the HALL Truck

(Established 1873)

Ferry Avenue and Grand Trunk Ry. **DETROIT, MICH.**

Eastern Distributor: R. D. King Motors Company, 9 Central Park West, New York City.



"One Hundred Tons a Day! Hardly Any Repairs! That's why we Recommend Signal Trucks!

"Our Five-Ton SIGNAL has made good on any Heavy Haulage load we've ›ut under it, and our ton-mile costs, after fourteen months' of heavy hammering over roughened and deep muddy roads, are as low as when it first went on the job."

"Making Good" is just Ordinary, Every Day SIGNAL Performance! Gliding Heavily-loaded over Rough roads one day; Climbing the next through Soft excavated material, or Pulling through Heavy, half-finished highways. And ready always to tackle the next task instanter! That's just a sample of SIGNAL "Make Good" Haulage.

So Hundreds of Contractors who are Aggressively "Making Good" are keeping down costs and increasing profits, agree in their opinion that the Proof of the Truck is in its ability to Make Good on Pulling Power!!! In all of these the SIGNAL has the "Make Good" Habit. We'll send you *Proofs* by the dozens.

Signal Trucks "Stand Up."

Signal Motor Truck Company, Detroit, U.S.A.

All sizes (1¼-1½ to 1¾, 2½, 4 and 5-ton) and all Worm Drive! Continental motors, Timken-Detroit axles, Brown-Lipe transmissions, etc.

Kissel Trucks Have Adaptability and Reserve Strength for Heavy Haulage Work

THERE are three different Kissel Truck Models—the *Freighter*, *Heavy Duty* and *Dreadnaught*—especially adapted for hauling loads, such as timbers, structural steel, piping, etc. In all three models the Kissel frame is designed to withstand the stress and strain of unexpected weight. The powerful Kissel-built brakes are quick to operate. The reliable Kissel-built power plant provides power of Niagara-like volume.

KISSEL TRUCKS

There are five new sizes—a truck for every business—a size for every purpose. In all the vital parts, the perfected worm drive rear axle, heavy duty front axle, springs, etc., the special steels and other metals, are chemically analyzed, heat-treated, milled and machined for accuracy and strength.

The New Kissel ALL-YEAR Cab

It is a warm, dry, closed cab, protecting your drivers in winter, increasing their efficiency and keeping your trucks in operation the year round, regardless of weather. In summer it is a cool, open housing.

Investigate the new Kissel Trucks and the ALL-YEAR Cab. Send for literature and specifications, or see your nearest Kissel dealer.

KISSEL MOTOR CAR COMPANY, Hartford, Wis., U.S.A.

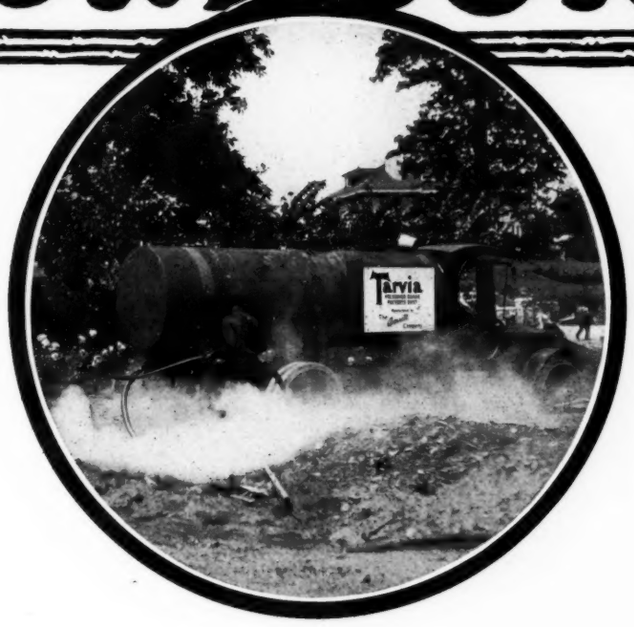
"THE *Easiest* Steering and the *Easiest* Driving Heavy Duty Motor Truck in the world." That's the Reputation already earned by the **"AMERICAN"!** Heavier, Stronger and More Accessible all the way through. Its Flexible drive (through the springs) Absorbs Jar and Vibration!

We have an Exceptionally Liberal Proposition for reliable truck dealers in our open territories. Write us for the territory you want.

No matter whether you're a Contractor or a Salesman, you should send for Illustrated Particulars concerning "American" Trucks.

American Motor Truck Co.
Detroit U.S.A.

HURLBURT



"Increased Mileage Per Gallon, with Heavy Loads.

"That's what we're getting out of our 5-ton, six-cylinder, worm-drive HURLBURTS," states the superintendent of a New York concern. "*Greater* power, *better* cooling, *smooth* operation, *less* strain, *even* torque all the time! A *continual*, vibrationless pull—*steady* and *sure!*"

The "dead load" (in **Hurlburts**) is cut down by the scientific reduction of weight through use of high-grade steels and alloys in place of the heavier, cheaper metals of larger proportions.

Although weighing less than other trucks in its class, **Hurlburts** have *more* strength, *more* power, *more* durability and *more* economy than trucks costing considerably more.

The HURLBURT Power Plant is in *excess* of all requirements, and equal to any emergency—the unexpected. ***More Miles*** per gallon of gas and oil; ***More Miles*** per tire; ***More Miles*** per bearing—that's what you get in HURLBURT Trucks.

Hurlburt Motor Truck Company

Third Ave. and Harlem River. **NEW YORK CITY.**

This 1½-ton Federal owned by the Brooklyn Department of Parks is daily demonstrating Federal low cost of operation. Other Federals are duplicating its performance throughout the country.

Nineteen Thousand Seven Hundred Miles with a Total Repair Expense of Only $68.33

Here's more proof of Federal economy of operation in municipal service.

This Federal, owned by the Brooklyn Department of Parks, has been in operation for one year eleven months, and in that period ran 19,700 miles with a total repair expense of only $68.33.

This is a graphic illustration of the kind of service Federals are giving throughout the country.

It is further proof of the rugged strength, the genuine durability, combined with economy of operation that has created the big demand for Federal Motor Trucks among municipalities.

"Federal Traffic News" is just what its name implies—it's a meaty little publication that will show you what Federals are accomplishing in the transportation field. Write for it.

Federal Motor Truck Company
352 Federal Street Detroit, Michigan

FEDERAL
One to Five Ton Capacities

VOL. LIV.
No. 2.

Municipal Engineering

CHICAGO, ILL.
FEBRUARY, 1918.

Design, Construction, Operation and Maintenance of all Public Works

For Military Highways and Main Market Roads

Good highways were never so much appreciated by the analytical as on the recent day when the fuel administrator issued his unprecedented order with a view to conserving the **available** coal supply. The word available is stressed, for the shortage of coal at the point of consumption is not due to a depletion of coal deposits, or even to inadequate coal mining, but is due primarily to poor transportation and distribution of coal after it is mined. That relief from these intolerable conditions can come only from comprehensive highway construction is easily shown.

About two years ago the Illinois State Geologist stated that less than one-half of 1 per cent of the known deposits of coal in this country had been mined out. There is no trouble on that point. The coal interests, both the owners and the miners' organizations, assert that coal is being mined in amounts which should be sufficient to meet the demand, and lay the blame for the trouble on the overburdened railroads; and the best information obtainable indicates that the inability of the railroads to handle the freight brought to them is the principal factor contributing to the coal shortage.

There was a time when we pitied the poor Indian who froze to death on top of a coal deposit because he didn't have sense enough to dig down for the coal. Thus was the inferiority of the red man established. The white man is smart enough to mine the coal, but he hasn't yet shown his ability to distribute it. He hasn't such a long intellectual lead over the red man as he thought.

The railways have been overtaxed for two reasons: they have been called on to handle an abnormally great and totally unexpected volume of traffic, and their facilities for handling even normal traffic have not kept pace with the peace time requirements of the country. In recent years railroad construction has hovered around the lowest level reached in a quarter century, and rolling stock and other physical property of the roads has been allowed to depreciate.

To attempt to fix the origin of the railway trouble is as idle as to discuss the classic hen and egg controversy. After centuries of debating this question, there is still lack of agreement as to whether the hen or the egg first came into the world. We might discuss the railway question for an equally long period without deciding whether the roads or the public are most to blame, but we haven't time—the Germans won't let us.

With the government operating the railroads there is no great relief in sight from those utilities. So far it is not known whether government control will terminate with the war or not, but it is doubtful if it will. This question is likely to be made a political football, for use after the war, to replace the antiquated tariff issue. Clearly relief must come soon, and we must turn to the highways for it, as the railroads have been found wanting, whether that be their fault, or that of the people, or that of the federal government, or of the forty-eight state governments, or of all combined.

Recently the fuel administrator stated that because of poor railroad facilities the shortage of bituminous coal this year amounts to 35,000,000 tons. Clearly the railroads lack the punch necessary to end this war by a knock-out. They marked time too long in the upbuilding of their properties. Whether they held back because of too much adverse legislation and too much government control, or whether they were prompted by motives akin to those of the beggar who encases his sound arm in a sling, it is now unnecessary and perhaps it would be impertinent to inquire. The summation of all factors in this problem has been made, and the result was the shutting down of the industries of half a continent.

Long before the railroads find out how they stand as to finance, management, ownership, etc., we must construct a system of comprehensive military highways and main market roads. Never again must the greatest coal-producing and the wealthiest nation on earth be made to close down its industries because it cannot distribute the coal already mined. Trunk line highways, if immediately begun, will by next winter make impossible a repetition of this year's unhappy experience. Such roads, with the aid of the motor truck, will relieve the railroads to such a degree that great congestion of rail traffic will not again occur.

Such roads will prevent coal shortages by handling coal direct and by handling other classes of freight on hauls up to 75 or 100 miles, leaving the steam lines free to handle the long-haul shipments. The distances named are, at present, considered about the limit of economical haulage with motor trucks on the highways, but they are likely to be increased materially as a result of experience and with the aid of a comprehensive system of first-class roads. Even uneconomical haulage at greater distances is preferable to no delivery at all. The cost of the shut-down in all states east of the Mississippi river, and in Louisiana and Minnesota, would make a very respectable start on the cost of adequate trunk line highways.

That this is a war problem we are well aware. Let us solve it rightly and at once. This is the people's war—yours, ours, everybody's. We must fight it and we must pay for it, and, above all, we must win it. To win it we must have adequate highway facilities, which, fortunately, will be of permanent value after the war is won.

Let us build these roads, win the war, and definitely and finally prove that we are a more intelligent race than the Indians who perished from cold because they couldn't cope successfully with the fuel problem.

Shall We Encourage a Revival of Sectionalism?

There is now a law on the federal statute books which, if permitted to become effective, will inevitably lead to a revival of sectionalism in this country. This law pertains to the second-class postage rate, and, unless repealed, will become effective on August 1 next. This ill-considered legislation was enacted in the pres-

ent revenue bill and divides the country up into zones. It will progressively increase the average cost of distributing newspapers and periodicals from 50 to 900 per cent. This will destroy many magazines of national circulation which, since the war started in Europe in 1914, have bravely struggled on under almost crushing loads.

Under this legislation the village and county newspapers will thrive at the expense of the journal of national circulation. This will make for provincialism and will naturally lead to intensification of local pride and prejudice.

There is already present a strong tendency for our vast country to split up along racial and purely artificial lines. The economic interests of one section of the country frequently differ radically from that of another. These economic differences have been composed in recent years by broad appeals that all sections work together, even at local sacrifice, for the good of the nation as a whole. These appeals have been carried by journals of national circulation, while the contrary appeals have been carried by local papers. If the local paper is left alone in its field it will state only the local aspect of every question. The only possible result of this course will be to strengthen the sectional and weaken the national consciousness of the individual. It is quite conceivable that this policy, if carried to its natural conclusion, will split the United States up into a half dozen sections, each section being envious of and more or less hostile to one or more of the other sections. This is sectionalism in its most virulent and mischievous form. Secessions and wars are among the plausible results of catering to sectionalism.

The fame of Lincoln rests not on his great heart, not on his eloquence, not on his emancipation of the slaves, but on his preservation of the union of the states. But for his success in this we should by now have several nations where there is but one. We should have a political system like that of Europe, with all its clashes of narrow national interests.

A careful attempt has been made to avoid the appearance of overstating the dangers to our country from the enforcement of this law. Readers who appreciate these dangers should use their influence to have this dangerous legislation annulled before it becomes operative.

Meterage for Chicago Again Recommended

Once again the meterage of Chicago's public water supply has been recommended. In a recent report the Chicago bureau of public efficiency recommended that a meter be placed on every water service line in the city; that meterage be inaugurated immediately and completed in ten years; and that the present misuse of water revenues for other corporate purposes be stopped. By adopting this program the city would, in the opinion of the bureau, save $1,600,000 by metering in the next ten years, and would avoid the expenditure of $15,000,000 additional on plant extensions.

Chicago now uses over 600,000,000 gals. of water per day, a per capita rate of 260 gals. The pumpage in 1916 was 14 per cent. greater than the entire supply of Greater New York, which has a population more than double that of Chicago.

It has been conservatively estimated by experts that 60 per cent. of the water pumped in Chicago is wasted. What a spectacle of municipal inefficiency! And who are to blame for this condition? The citizen and his representative in the city council. In truth, the alderman frowns on meterage because he knows the thought of metering his water supply is abhorrent to the Chicagoan. Representative government appears at its best and worst in Chicago—the aldermen give the people what the people think they want. The typical Chicago alderman has, for years, believed in meterage for every ward in the city but his own.

The average citizen thinks a meter will raise his water bill if he continues to use all the water he needs. Some think that meterage will be injurious to the public health, as it will lower the use of water to a point below the hygienic requirements. These are the stock objections which have been raised in every city in America for the past quarter century, when meterage has been seriously advocated. Both are groundless, as the experience of hundreds of cities has demonstrated.

In few cities, if any, have the uninformed people demanded the metering of the public water supply. This is something that must be administered to the protesting public by its better informed servants. How much longer will it take the Chicago council to meet this issue squarely and to decide it on economic grounds in the ultimate interest of the public?

The Farmer and Road Machinery

Ever since the American farmer started working out his poll tax on the road, he has looked upon road work as somewhat in his line. He has been willing to drag the roads, for a consideration, in some localities. The few dollars in cash he has been able to pick up on the road have helped to tide him over between seed time and harvest. For these reasons he has not always regarded with favor the purchase of road machinery by the township officials.

Now conditions have changed on the farm to such a degree that the farmer no longer seeks an opportunity to work on the road. Because of the shortage of farm labor, and the effort to produce a bumper crop each year, the farmer has his hands full with his farm work. This is a condition to which the manufacturers of road machinery are said to be reconciled. This will be the best year ever for the sale of road maintenance machinery.

Over Three Thousand

Since June, 1917, MUNICIPAL ENGINEERING has secured 3,487 (three thousand four hundred and eighty-seven) New, Cash, Paid-In-Advance subscribers.

And each and every one of these new subscriptions covers a period of one year and at the Regular $2 (per annum) Subscription Price of this publication. There is no camouflage about it. We received the Cash in each and every transaction.

In all of our twenty-eight years we have never made such a record. In June, 1917, we set a High Mark we would reach by June, 1918—and We Will Make It.

This issue of MUNICIPAL ENGINEERING will be read by More Engineers and Contractors (specializing in the Design and Construction of Streets, Roads, Sewers, Bridges, Waterworks extension, etc.) than ever before; and that number will be Increased each issue. Why? Because MUNICIPAL ENGINEERING is known as a thoroughly Reliable engineering magazine—everything in it is measured by the yardstick of Truth and Reliability before it is accepted for publication.

Details of the Design and Construction of the Water Supply of Camp Meade, Md., 79th National Army Division

By Morris Knowles, Pittsburgh, Pa., Mem. Am. Soc. C. E. and M. Am. Inst. Cons. Engs., Supervising Engineer, Camp Meade.

Camp Meade, the cantonment for the 79th National Army Division, is located between Baltimore and Washington, near Admiral, Md. It is situated between the Pennsylvania and the Baltimore & Ohio railroads, and is also reached by the Washington, Baltimore & Annapolis Electric Railway, and is sufficiently large to care for about 50,000 troops. In the building of these "army cities" one of the prime considerations was the sanitary and health conditions, so that the water supply problem was one which gained immediate attention and exhaustive investigation.

Temporary and Permanent Supplies

In considering a water supply for a cantonment located like Camp Meade, or almost any other cantonment, there are two distinct and separate supplies which have to be kept in mind; one of a temporary nature, which must be made available in a short time, for immediate use during the construction period, and the permanent supply for the use of the cantonment.

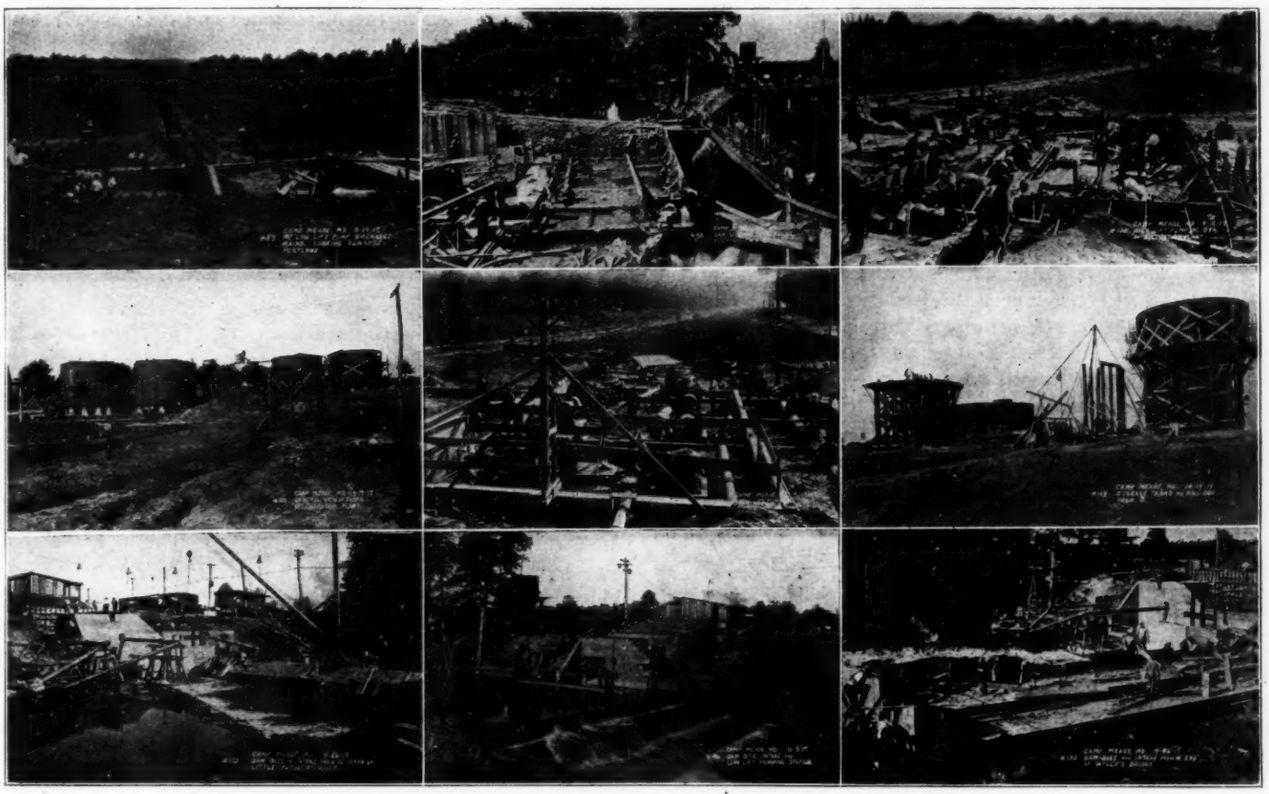
The Temporary Supply

The temporary supply may be of such a nature that it can be later incorporated into the final system, or it may be of such a nature that it is not adapted to use with the system which is finally built.

At Camp Meade the temporary supply was procured from some of the original farm wells and deep wells driven at various points on the reservation, which were located with the idea in view of later tying them into the distribution system for the camp. They are all deep wells and so situated and planned that in an emergency they can furnish a limited supply of water into the permanent system.

The Permanent Supply

In designing the regular system, a complete study was made of all the rainfall and stream flow data, procurable from the U. S. G. S. and Maryland State Department of Health and also a sanitary survey of the watershed of the little Patuxent River. With these data at hand it was decided to take the supply from the Little Patuxent River near Welch's Bridge, which has a dry weather flow of 4 M. G. D. and an average flow of 112 M. G. D.



VIEWS SHOWING CONSTRUCTION OF CAMP MEADE, MD., WATER SUPPLY WORKS.

Left to Right: Two 12-in. Wood Stave Lines Connecting Low Service Pump Station and Filter Plant—Bypass Flume at Patuxent Dam and Intake—High Lift Pump Station Showing Location, Pumps and Motors—General View of Filter Plant Showing Clear Wells, Sedimentation Basins and Filter and Alum Tanks Before Construction of Superstructure—Pipe Connections, High Lift Pump Station—Construction of Storage Reservoirs—Dam and Intake on Little Patuxent River—Dam Site and Intake About Completed—Construction of Dam and Intake.

The water of the river is generally turbid and carries considerable quantities of colloidal clay. It is also somewhat polluted from the habitations on the drainage area, which generally dispose of their wastes in pits and cesspools; although there are a few institutions and villages which have treatment works and run their effluent into the stream. These conditions made coagulation and filtration necessary and the lime-alum treatment, with rapid sand filters, was finally adopted, the water being chlorinated after leaving the filters.

Essential Elements in the Design.

The system as finally designed, under the direction of Mr. W. H. C. Ramsey, Division Engineer, in charge of Water and Electric Systems, consists of a diversion dam and intake, leading to a set of low-lift pumps, which pump the water to the sedimentation basins. There it is treated and run by gravity through the filters and over to a set of high lift pumps, which feed into the distribution system and also supply the storage tanks, which act as equalizers on the system and as an emergency supply for fire protection. Smith, Hauser and McIsaac, Inc., were the general contractors, for this work as well as the entire Cantonment work.

Construction Details and Methods

Dam. The dam at the intake is log crib construction, filled with stone and gravel, and is 7 ft. higher than creek bottom. Under the dam, at the creek level, there are two rectangular wooden blow-offs, 18 in. high by 5 ft. wide, with sluice gates on the up-stream face of the dam.

Intake. The intake is of reinforced concrete and is placed with its lower end 6 ft. up-stream from the face of the dam and with one side parallel to the creek and in line with the edge of the stream. It is designed to take the water from the top of the stream rather than from the creek bed, in order to prevent the drawing of sand and debris into the intake chamber during low water. It is constructed with three chambers, two of which are catch pits for sand and gravel; and third a side chamber which forms the suction chamber.

The water enters the intake over a weir wall set 9 in. lower than the crest of the dam and flows over a set of bar screens placed as a cover over the two catch pits. By reason of the stilling action of the intake, any supsended matter is dropped into this up-stream catch pit. The water required for the pump suction passes through this bar screen into the catch pit, thence through two sets of vertical screens made of No. 10 copper and ¼-in. mesh into the suction chamber. Each of the catch pits is provided with a 12-in. drain pipe passing through the log crib dam.

The weir wall of the first catch pit, over which the water first enters, is provided with grooves for the reception of stop planks, which are so placed to prevent the water from entering the intake when it is necessary to work at the foot valves or in the intake. On the down-stream wall of the second catch pit another groove is placed for the reception of stop planks which are to be changed from day to day as the level of the water over the crest of the dam varies. These planks are to be regulated to such height that the water will pass over them at a depth of approximately 1 or 2 ins. When operated in this manner the depth of water on the crest of the dam is considerably greater than that flowing over the stop planks, thus insuring a far greater velocity of water down-stream than through the intake, and debris will thus be carried over the crest of the dam by reason of this velocity.

Lime Treating Plant. Contiguous to the concrete intake is a lime treating and storage plant. This equipment consists of two tanks equipped with motor driven stirring devices, and a small motor-driven lime mixing chamber and standard orifice feed tank. The lime is carried into the suction chamber of the intake and is discharged between the two pump suctions, on a level with the foot valves, and just inside the fine mesh screens.

Low Lift Pumping Station. The low lift pumping station is located close to the intake and in order to keep the suction lift low it was found necessary to place the pumps in a pit which has watertight concrete walls and floor. The pumps are belt connected, motor-driven, the motors being placed on a floor about 7 ft. above the pumps. The installation consists of two 1,000-g.p.m. and one 750-g.p.m. single-stage centrifugal pumps.

The 8-in. discharge lines are manifolded immediately into two 14-in. mains cross connected by a 12-in. gated pipe. After about 100 ft. of 14-in. mains the line is reduced to two 12-in. wood stave mains 3,260 ft. long, which lead to the filtration plant about 80 ft. higher.

Filter Plant. The filter plant consists of two 100,000 gal. wooden tanks used as sedimentation basins and six filter tubs with a capacity of 500,000 gals. per day each. The filter bed consists of 15 ins. of coarse gravel and 24 ins. of sand. The filter tubs are of the high velocity wash type, requiring approximately 15 gals. per square foot of filter area per minute.

The super-structure is one-story high over the northern end of the building and two stories over the southern end. Two alum tanks are located in the second story. These tanks are equipped with three orifice feed tanks, two discharging through separate lead lines into their individual sedimentation tanks and the third connected by lead line to the influent main just ahead of the filters.

Chlorination. Two solution feed type liquid chlorine machines are installed in the filter house and discharge into the effluent main.

Clear Wells. The clear wells are about 135 ft. west of the filter plant. There are two of these tanks similar to the sedimentation tanks and with a capacity of 100,000 gals. each.

High Lift Pumping Station. The high lift pumping station is located just west of the clear water tanks, and contains two 1,000-g.p.m. and one 750-g.p.m., two-stage, centrifugal, belt-connected, motor-driven pumps, designed to operate against a head of 250 ft. The discharge from these pumps is carried through two 14-in. mains, cross connected by a 12-in. gated main. These 14-in. mains are reduced to 12 in. shortly after leaving the station, which mains lead to the distribution system and eventually to the four 100,000-gal. redwood tanks, located on the northerly corner of the reservation. These tanks serve a double purpose—to maintain a uniform pressure in the system and to act as a reserve for fire protection.

Camp Meade is one of the cantonments where so elaborate a system of water works is required, including, as it does, a complete purification equipment. Although a surface stream is used, the recent health reports show that the morbidity and mortality records are lower here than at other camps, with practically a total absence of any water-borne diseases.

Military Roads Essential—Ten Billions of Farm Products and Only Five Per Cent. of Good Roads

By F. A. Churchill, Conneaut, Ohio

At variance with public understanding, as it may be, the responsible heads of cabinets at Washington are thoroughly convinced that road building is vitally essential to the successful prosecution of the war as a means of transportation of supplies which cannot be handled by the railroads. Secretary Baker of the War Department, and Secretary Redfield of the Department of Commerce, have declared this necessity in unqualified terms. It is chiefly because of the now generally condemned Order No. 2, issued by Judge Lovett of the Board of Priority, that public belief in the undesirability of road building during the war has arisen. Fortunately, this priority order has been lifted for the present at least.

Early Hysteria Is Passing

It is true that at the outbreak of the war, officials in Washington and the Governors of certain states, became hysterical and advised total suspension of road building; but that was an exhibition of mental unbalance due to temporary paralysis of the sense of proportion.

When war was declared the shock was too great for some

official minds at Washington and elsewhere to function properly. The magnitude and complexity of the problems confronted led to hasty judgments and impulsive action. Without due consideration, and on the spur of the moment, unwise advice was given, and, unfortunately, in some instances that advice was accepted at its face value and acted upon by state, county and municipal authorities.

Now, however, such men as Secretaries Baker and Redfield, and the United States Chamber of Commerce and leading magazines and newspapers see the folly of suspending road building, and gradually the public is getting a more clarified vision of the intimate relations betwen good roads and war supplies.

One of the most regrettable and harmful effects of the early spasm of irrationality on the part of officialdom is noted in the attitude assumed toward paving bonds by investment houses here and there. Some of these houses, under the mistaken impression that they were aiding in the conservation of energy and money needed for war purposes, shut down on investments in bonds issued for road improvements. This action hampers some communities that have taken a sane view of the situation and have gone ahead with road-building projects.

Not long ago President Wilson said: "It is perfectly obvious that you have got to have an intricate and perfect network of roads throughout the length and breadth of this great continent before you will have released the energies of America." The allies are depending on the energies of America. Unless they are released and given full play there is grave danger of losing the war. Road construction is, therefore, imperatively requisite to national defense and security.

War Department Demands Better Roads

One of the most encouraging signs of the times in respect of road building is the urgent demand for better roads that is issuing from the War Department. Secretary Baker is echoing the voice of discerning men of influence in all parts of the country.

Reflection has shown the public the fallacious nature of the policy of increasing production and at the same time curtailing transportation facilities. Men who are in touch with practical conditions understand clearly that for transportation purposes no road is better than its worst section. A half mile of bad road fixes the maximum load that can be hauled over the road, although there may be 200 miles of good pavement elsewhere on the route.

The building of continuous through roads is imperatively essential to motor truck traffic. Main roads everywhere should have gaps closed and they should be completed from logical starting point to logical terminals. Lateral feeders of main roads should also be improved in such manner as to bear heavy traffic without wearing out in a few years.

Only 5 Per Cent of U. S. Roads Improved.

Let it be borne in mind that only about 5% of the 2,400,000 miles of highways in the United States are what may be called suitably improved. Yet over these roads must be hauled the products of 6,361,502 farms, comprising 878,798,325 acres of land, in 30,000 townships in 48 states. These products in 1915 were worth $10,501,686,375, and 12,659,208 persons were engaged in the production.

In view of the foregoing facts in these times of need, when supplies are vitally essential and means of transportation are notoriously inadequate, is it unreasonable to demand energetic prosecution of road-building enterprise?

Military Roads Must Be Dependable

Federal and state authorities are beginning to realize the vital necessity for dependable roads for military purposes. Types of road which serve ordinary traffic purposes will not do, especially for roads over which the enormous 10-ton and 15-ton motor truck traffic at camps and cantonments must go. Therefore, roads leading to Camp Benjamin Harrison, near Indianapolis; Camp Johnston, near Jacksonville, Fla.; Camp McClellan, Anniston, Ala.; Camp Grant, Rockford, Ill.; Camp Dodge, Des Moines, Iowa; Camp Sherman, Chillicothe, Ohio, etc., have been paved with wire-cut lug brick. In some of the cantonments the main streets also are paved with brick, because the enormous weight and volume of traffic demands a high type and durable smooth-surface pavement.

Secretary Redfield, of the Department of Commerce, in a published interview, tells how the supposedly good improved roads of New Jersey, leading to the cantonment at Wrightstown, were torn to pieces in a very short time after the camp was established.

Trucks weighing 10 tons and 12 tons each, traveling 20 miles an hour, and passing at intervals of 40 seconds, as reported from some of the cantonments, require roads that can stand not only tremendous loads but the most severe abrasion tests as well. Roads which require constant maintenance and frequent repairs in order to keep them serviceable are not suited for military purposes. Surfaces which wear or pit or ravel or disintegrate under heavy traffic stresses cannot qualify for military service.

Extraordinary conditions prevail in times of war. Vast quantities of materials must be transported by highways. Roads for assembling and distributing food stuffs are as essentially military as roads over which munitions must pass. An army must be fed as well as equipped. The product of 6,000,000 farms cannot be made available without highways serviceable for heavy hauling 365 days in the year.

Every Road Now a Military Road.

The summation of the whole matter is this: Every road over which supplies of any kind must be hauled by wagon or by auto truck is a military road in times like these. Improvements which will give these roads the highest efficiency in facilitating quick transportation of supplies in maximum quantities are a military necessity. The essential and indispensable qualities of military highways are smooth surfaces and great durability.

Traffic conditions have been revolutionized. Nothing except the highest type of road can withstand the enormous loads and abrasive stresses of the kind of traffic developed by the war—a traffic which will continue in kind and increase in volume, in response to commercial requirements, for an indefinite period after the war shall have ended. The era of light traffic is gone forever.

Hydraulic Conversion Tables and Convenient Equivalents

Here is a Water Supply Paper (No. 425-C), issued by the United States Geological Survey, of more than local interest. It is entitled: Hydraulic Conversion Tables and Convenient Equivalents. It is a reprint of pp. 71-94 of Contributions to the Hydrology of the United States, 1917. The convenient equivalents cover, length, surface, volume, hydraulics, miscellaneous and map scales.

Using Portable Air Equipment on Brick Pavement Repairs

The use of portable air compressors and air hammers for use in brick pavement repair for cutting out joints and cleaning brick is well established in Cleveland and vicinity. There are 15 or 20 outfits of this sort in use by contractors in and near Cleveland. The county engineer of Cuyahoga County has two outfits, and several contractors have two or more. With one of these machines one man can clean as many birck as five men by hand, and in cutting joints one man can do as much as ten men by hand. This is the observation of D. Moomaw, Road Engineer of Cuyahoga County, Cleveland.

PAVEMENT DESIGN AND CONSTRUCTION

Data on Operation of Asphalt Mixing Plant Owned by City of Worcester, Mass.

By Albert T. Rhodes, Commissioner Street Department, Worcester, Mass.

The Cummer Mixing Plant, owned by the street department of the city of Worcester, is producing for us an average amount of about 100 sq. yds. of 2-in. Topeka top per hour of operation. This we feel gives a better idea of the production than the so-called daily production, because some people are basing their output on a 10-hour day and some only on an 8-hour day; but we find under normal conditions that our average output is about 100 sq. yds. per hour, of 2-in. top.

Organization and Duties of Force

The plant is very conveniently situated, the materials coming in on a platform at the same level as the kettles, thus bringing the heavy materials at a convenient level for disposition into the plant. The plant is operated by one plant foreman, who looks after the grading of the materials on screen tests and who sets the mix; one fireman, who looks after both the heating of the large drying drum and the fires under the asphalt kettles; one dipper man, who fills the asphalt scales with their proper weight of bitumen; one man who looks after the mixing box, seeing that the mixture is at its proper consistency and dumping it into trucks; one man on sand and screening box scales, who weighs out the proper amount of mixed sand and traprock screenings and puts same into the mixing boxes; one man on ground lime rock filler; two sand wheelers; two wheelers of traprock screenings; one man on the hopper into which same are delivered; and one man on the bucket elevator. One spare man during the day fills up the asphalt kettles and acts as an emergency man, in case of any difficulty occuring at the plant, or the necessity arises for an extra man at any point during the operation.

Duties of Night Watchmen

In addition to the above force there are kept two men as watchmen over this yard. One arrives at 4 o'clock in the afternoon and looks after the cooling down of the machine. It is absolutely necessary to operate the drum for a very considerable time after shutting down the plant, in order not to warp it out of shape. This is on account of heat being concentrated on one side of the drum while it is cooling on the other. This man looks after this cooling-off process and is relieved at 12 o'clock midnight by another watchman, who starts the fires early in the morning to get the plant and the asphalt for the mixture warmed up for the other workmen, who arrive at 7 or 8 o'clock, as the case may be.

Handling Raw Materials and Operation of Plant

The sand and traprock screenings come in on a platform back of the machine and are wheeled in wheel barrows into a hopper, which delivers to the bucket chain. It has been found necessary to keep a man at the hopper and also at the bucket chain, on account of the mixture of sand and screenings standing almost perpendicularly, without falling either down into the hopper or into the bucket chain. The mixture of sand and traprock screenings is delivered from the bucket chain into the drying drum, from which, after being thoroughly dried and the fine dust driven off by a suction fan, it is delivered to another bucket conveyor, which conveys the dried material to a hopper over the weighing bin, into which it is taken in the proper quantity from the hopper above. When the proper weight of sand and screenings has been delivered into the weighing box, it is from there delivered into the mixing box, at which time the proper amount of asphalt by weight is delivered into the asphalt weighing box from the asphalt kettles, and the paddles quickly churn the mixture to the proper consistency, from which it is dropped into the waiting trucks or wagons beneath and carted to the job. Two asphalt kettles are filled with 750 gals. each, and from time to time during the day more is added, bringing the amount up to about 1,000 gals. each.

The Mixed Material

The mixed material is drawn to the place at which it is to be used in either trucks or carts, which have been thoroughly greased inside with crude oil, this crude oil keeping the mixture from sticking to the sides of the vehicle. The mixture

VIEWS OF ASPHALT MIXING PLANT OWNED AND OPERATED BY CITY OF WORCESTER, MASS.

used is composed of the following ingredients and in proportions as indicated:

55 lbs. asphalt to 500 lbs. sand and screenings (½ of each).
35 lbs. filler (ground marble dust).

Applying the Mixed Material

The number of men on the job to receive the top and apply same is composed of a foreman, three rakers, two tampers, two ironers, five shovellers, one finisher, a watchman, together with a tandem roller and engineer. Three trucks are used for transportation within city limits.

The material is dumped on a prepared and thoroughly rolled base of old macadam, or a concrete base, whichever may be used. It is shoveled from the load as dumped, spread by rakes to the proper thickness and grade, and tamped next to the railroad tracks and curbs by hand tampers. It is allowed to cool to the proper condition in which it will take a tandem roller without sticking to the wheels, after which

the roller is passed over the top surface. If the roller is not provided with proper sprinkling devices for water sprinkling, either ground lime stone dust or common Portland cement is broomed on the top surface to keep the asphalt from sticking to the roller wheels.

Rolling

It is given a thorough rolling by a 6-ton tandem roller, followed by a heavier roller, weighing anywhere from 10 to 15 tons. The edges at the curb and at the railroad tracks are painted with a composition of asphalt, such as is used in the mixture, and following the tamping and rolling an iron heated in an open brazier is used to iron the surface at the curb, or at the railroad tracks, to a proper top finish, to fill in all the voids and make a proper tight job at these points.

The rolling is done as far as possible longitudinally and transversally. If it is not possible to roll transversally in the proper manner, the "S" type of rolling is followed and then reversed in the manner of a figure 8. In this way the cross rolling is accomplished without running against the curbs, in which case on the reverse motion of the roller the probability is that a hole would be formed in the soft pavement. The finished product gives a clean, sanitary, reasonably durable top surface, which can be flushed in the proper manner, similar to any hard top pavement.

Cost

The cost in the city of Worcester during the season of 1917 varied from $1.14 to $1.33 per sq. yd., which included the preparing of the subgrade, rolling it and the complete 2-in. topping. This price is extremely high, however, on account of the fact that the streets thus treated were old macadam streets, on which one layer after another of macadam had been applied, bringing the existing surface at the time of this work very much above the proper grade and necessitating the carting away of a very considerable quantity of material, in order to get the finished subgrade down to the proper point to take the 2-in. topping.

Specifications for Asphalt-on-Concrete-Base Road Construction

By D. T. Pierce, Executive Assistant, Barber Asphalt Paving Co., Philadelphia, Pa.

Recent reports of contracts awarded for the construction of mixed-top asphalt roads on a concrete base leave no doubt as to the increasing popularity of this type. The reports are taken at random from the daily records of the Barber Asphalt Paving Co. and represent large yardages in Pennsylvania, Kentucky, Mississippi, West Virginia, Oklahoma, Ohio, Indiana, Illinois, Iowa and other states, this brief list indicating wide distribution rather than the number of communities laying mixed method roads with natural asphalt on a Portland cement concrete base. In addition to the states actually building this type of road, several highway departments are turning to it, partly as a result of high costs of other types and partly as a result of the demonstration of its durability now covering a period of many years.

Advantages of the Type

Owing to the moderate cost of the base and the rapidity with which it can be laid and utilized, the type offers a short cut to a highly essential requirement of modern highways, namely, the carrying of increasing weight of traffic. The ease with which an asphaltic top may be kept in repair without disturbing the concrete base is another advantage claimed for this type of road.

The combination road described does not mean a concrete road with a superficial covering of stone chips bound with asphalt or tar, for the wearing surface includes advantages not found in these very thin tops or carpet coatings. It is not only designed to withstand years of traffic, but must be sufficiently thick and impervious to protect the concrete from destructive changes in moisture content and temperature, particularly the former. Practical experience extending over a long period of years has demonstrated that a substantial 2-in. asphaltic surface will prevent the upheaval or disintegration of concrete, as extreme expansion and contraction do not occur.

A Good Specification

It could easily have been foretold, and now experience is demonstrating, that durable asphaltic wearing surfaces can not be built unless careful attention is given to the grading or proportioning of the aggregate. To specify simply a 65-35 per cent. mixture of stone and sand will not make a durable wearing surface; it would not even make good close binder. One good specification under which a large yardage of successful work has been done is the following:

Mineral Aggregate—The mineral aggregate shall consist of sand, crushed trap rock, hard limestone or other stone of equal quality, free from weathered and dirty particles, and a finely powdered mineral filler, all of which shall meet the approval of the engineer.

Sand—The sand shall be a natural bank or river sand, consisting of hard and angular, but not necessarily sharp, grains, all of which will pass a 10-mesh screen and not contain more than 3 per cent. of clay or loam. On sifting, at least 15 per cent. shall be retained on a 30-mesh screen, and at least 22 per cent. shall pass an 80-mesh and be retained on a 200-mesh screen.

VIEW OF ASPHALT-ON-CONCRETE BASE ROAD BUILT ON BUSTLETON AVE., BY PHILADELPHIA BUREAU OF HIGHWAYS.

Stone—The crushed trap rock shall all pass a screen of two (2) meshes to the lineal inch and all be retained on a 10-mesh screen, or the run of crusher trap rock can be used, provided the portion passing the 10-mesh screen is of suitable grading to serve as sand and filler, in which event only sufficient sand and filler will be added to insure the proper proportion of sand and filler in the mineral aggregate.

Filler—If the screenings do not contain sufficient 200-mesh particles, they shall be supplied by the addition of a suitable amount of ground limestone, or any other mineral matter (or Portland cement) of sufficient density to produce a powder having a volume of weight when ultimately compacted of at least 90 lbs. to the cubic foot. It shall be so fine that at least 75 per cent. shall pass a 200-mesh screen.

Combining Materials—The sand and stone complying with the above specifications shall be heated in a suitable plant to a temperature of from 300 to 350 degrees F., and shall be combined and thoroughly mixed while hot by machinery, in such proportions that the finished mixture shall contain not more

than from 8 to 22 per cent. of aggregate passing a 4-mesh and retained on a 10-mesh screen and less than 10 per cent passing a 2-mesh and retained on a 4-mesh screen.

Philadelphia Bureau of Highways Specification

The specification used by the Bureau of Highways of Philadelphia is even simpler than the above. It provides:

"The stone shall consist of sound, hard, crushed trap rock, with a coefficient of wear of not less than 15, or limestone, with a coefficient of wear of not less than 10, free from dust and passing a ¾-in. ring.

"The surface mixture shall consist of asphalt cement, crushed stone, sand and Portland cement or stone dust, so that the resulting mixture will contain the several materials in average proportions of the whole mixture, as follows:

Bitumen	7 to 9 per cent.
Dust or Portland cement	12 to 14 per cent.
Sand, coarse or fine	35 to 40 per cent.
Crushed stone	40 to 50 per cent.

"The proportions shall be fixed within the limits designated by and at the discretion of the engineer. The proportion of fine sand passing a 200-mesh sieve shall not exceed 2½ per cent. of the total mixture."

The Philadelphia Highway Bureau has jurisdiction over many miles of roads so remote from the thickly populated sections of the city as to bring them within the country road class. Their improvement, however, has invariably resulted in increased traffic, thus subjecting them to thorough test. The bureau has found the combination road very satisfactory and economical, and it is now among the city's standard types for heavy traffic roads.

Typical Philadelphia Road of This Type

A typical Philadelphia combination road is shown in the accompanying picture of Bustleton avenue, which, at the section shown, runs through an agricultural district. This road consists of a 4-in. concrete base and curbs and a 2-in. asphaltic concrete top. It was finished in January, 1916, unit costs as given by the highway bureau being as follows:

Portland cement concrete base	$4.36 per cu. yd.
Asphalt paint coat applied to surface of concrete base	.05 per sq. yd.
Bituminous surface	.60 per sq. yd.

These prices mean about $11,000 a mile for a 16-ft. road.

The wearing surfaces of these roads have the slightly yielding or resilient quality required by both horse and motor traffic. Should a new surface be required after years of traffic, the city, at the price given above, would obtain practically a new road for less than $6,000 a mile. This fact emphasizes the value of a concrete base as a permanent and economical investment, as it is a constant support to the wearing surface and calculated to last indefinitely. Incidentally, the Philadelphia Bureau has experimented with practically every type of highway in the form of so-called test roads, and the fact that preference is given the combination road for heavy traffic thoroughfares is strong endorsement of the type.

Careless Construction Causes Early Failure of a Brick Pavement

By Harlan H. Edwards, Highway Engineer, 2831 Washington Blvd., Chicago, Ill.

Poor design, indifferent inspection, and careless construction have caused considerable waste of money by shortening the life of many of our brick pavements built by local authorities without competent engineering supervision. In and near most municipalities may be found excellent examples of the waste of public funds caused by the deliberate disregard of the principles of good paving practice and the apparent absence of common sense and good judgment in those responsible for the work. The failures of these pavements have afforded opportunity to unscrupulous politicians or competing material men to bring discredit upon the good name of durable paving material which has been damaged or destroyed by poor workmanship. Such an example is found on the road running south from Danville, Ill. to Lyons.

Grouted Brick Pavement

This road was surfaced with a grouted brick pavement scarcely five years ago, yet now, in spots aggregating about 30% of the surface, the grouted joints have failed, causing spots of crushed brick, crushed grout, and a section of pavement some 1,000 ft. in length wherein the grout filler has failed entirely. There is little excuse for such an occurrence, yet it emphasises the principle that a little cement poorly placed is much worse than no cement at all.

Design of Pavement

As constructed, the brick road is 12 ft. wide, laid on a 4-in. concrete foundation with a 6-in. curb, having the 4-in. Danville wire-cut-lug pavers laid on a 1½-in. sand cushion.

BRICK PAVEMENT, DANVILLE, ILL. WHERE CEMENT FILLER FAILED WIDTH OF PAVEMENT, BUT WIRE-CUT-LUG BRICK REMAINED PRACTICALLY PERFECT.

Poured expansion joints were placed every 50 ft. through the brick slab. Part of the work was done during cold weather, which may account for the entire failure of the grout in one section.

Proper Construction of a Grouted Pavement

In any grouted pavement it is essential that the joints be free from sand or other foreign material, and be filled the entire depth of the brick with the cement grout, thus cementing the separate brick into a solid slab. Then, as the temperature rises and falls, and expansion or contraction takes place, the stresses set up will be equally distributed over the entire depth of the brick. On this work, however, the joints were filled in places but 1 in. or less at the top, thus bringing the stress from expansion entirely upon this top section. This force in some places was great enough to shatter or pop-off the top of the brick or crush the cement filler, destroying the bond, and ultimately subjecting the entire pavement to destruction.

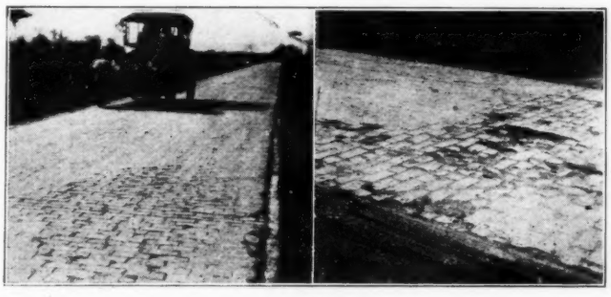
Failure in Spots

In this case, as in most pavements, the failure did not come in the entire pavement, but rather occurred in spots where the grout had been carelessly applied or was of a too thick consistency, so that it bridged over the joints and failed

to penetrate the full depth. This trouble was also noticed where in rolling the brick surface the sand had worked up between the brick 2 or 3 ins., preventing the further penetration of the grout.

Most Failures at Expansion Joints

The greater number of the failures of the grouted joints, however, started in the rows of brick adjacent to the expansion joints, and spread for the greatest distance in both directions along the wheel-traveled way. Since at each expansion joint the adjacent brick were not solidly supported by the sand cushion, and were rigidly held in place only by the adhesive power of the grout on one side, the impact and longitudinal thrust of horse and motor traffic constituted a turning force acting on and tending to push the top of the brick into the space occupied by the elastic or plastic expansion joint. This soon broke the bond in the grouted joint, and allowed water to penetrate and saturate the sand cushion.



PAVEMENT FAILURE DUE TO CARELESS CONSTRUCTION.

Greatest Number of Failures Started at Expansion Joints and Spread Along Wheel Track. Impact of Heavy Wheels Over Uneven Surface Resulted in Ruts and Crushed Brick.

The initial step being thus accomplished, the failure of the succeeding joints in the pavement was hastened by the combined action of traffic and the water in the sand cushion. Its lubricating qualities, combined with the vibration from traffic, caused the sand to shift and compact, leaving a hollow space under this part of the slab. As traffic moved over this and adjoining sections, great shearing and tensile stresses were put upon the grouted joints, ultimately causing their failure and consequently increasing the area of failure, especially along the wheel-track. More wear was caused at these spots by the hammer-like impact of heavy wheels over the uneven surface, ultimately resulting in ruts, bumps, and crushed brick at each place. This destructive action was undoubtedly hastened by the freezing and consequent expansion of the water in the sand cushion.

Uniform Disintegration of Grout

In one section, however, opportunity was not given for this to happen, for the grout shattered or disintegrated uniformly in the entire pavement for a space of about 1,000 ft. This, then, produced a condition similar to a sand-filled brick pavement. In a sand-filled brick pavement straight wire-cut or repressed brick are used, leaving but a small, narrow joint, while here the wide joints made by the wire-cut-lug brick afford an excellent opportunity for heavy wagons, etc. to break off and cobble the edges of the brick. It is interesting to note here, however, that in this section of the pavement the brick have remained practically perfect even though the cement grout filler has failed completely.

Competent and Constant Supervision Requisite

Such failures as these illustrate not only what has happened but also what is very likely to happen to grouted brick pavements designed and built without constant and competent supervision. Although no pavement is more permanent than one built with uniformly hard and tough vitrified paving brick, properly placed on a solid foundation, still no pavement is much more uncomfortable to ride over than these same brick pavements carelessly put in and subsequently taken up to repair or install pipes and wires underneath. It is not the intention of the writer to condemn sand cushion brick pavements in which the joints are filled with sand or bituminous material, for some of our best old pavements are those of the sand-filled type; but rather to point out that no matter how perfect the brick or cement may be, if careless construction be permitted, failure of the wearing surface will almost invariably occur at an early period, thus bringing to mind again the fact that a little cement poorly placed is much worse than no cement at all.

Monolithic Construction Eliminates Many Causes of Failure

The introduction of the monolithic and semi-monolithic ideas in brick pavement construction has eliminated many causes of failure by affording a rigid foundation for each brick, yet a large number of our cities continue to construct the sand cushion grouted brick pavements under the "supervision" of non-technical political appointees, and then condemn the materials used when after three or four years of use failure begins to occur.

Approved Practice in the Construction of Granite Block Pavements

By Clarence D. Pollock, of Pollock and Taber, Consulting Engineers, Park Row Building, New York City.

The present standard granite paving block has a width of from 3½ to 4½ in., a length of 8 in. to 12 in. and a depth of 4¾ in. to 5¼ in.

Standard Blocks

Further requirements are that "the paving blocks shall be of medium grained granite, showing an even distribution of constituent materials, of uniform quality, structure and texture, without seams, scales or disintegration, free from an excess of mica or feldspar. The blocks shall be so dressed that the faces will be approximately rectangular in shape and the ends and sides sufficiently smooth to permit the blocks to be laid with joints not exceeding ½ in. in width at the top, and for 1 in. downward therefrom, and not exceeding 1 in. in width at any other part of the joint. The top surface of the block shall be so cut that there will be no depressions measuring more than ⅜ in. from a straight edge laid in any direction on the top and parallel to the general surface thereof."

The above requirements are in the specifications of the American Society of Municipal Improvements, and are now in very general use.

Variations from Standard

Of course, there are numerous exceptions to these standard blocks. A few cities specify a block with a length of 6 to 10 ft. with a top surface or head cut so that there will be no depressions measuring more than ¼ in. and to lay to a joint not exceeding ⅜ in. Such a specification may produce a pavement with possibly 10 per cent. of the joints better than with the standard specifications, but as the area of the head of the block is smaller and consequently more blocks are required to the square yard, it adds considerable to the cost of the pavement and the writer is of the opinion that this extra expense is not warranted except in rare instances.

Joint Thickness

When standard blocks are well cut and properly paved under the specifications that the joints shall not exceed ½ in. in width, something like 75 per cent. of the joints will comply with the more rigid specification and it would seem unnecessary to spend an additional 40 or 50 cents per square yard to have possibly another 10 per cent. of the joints a little closer. Such a requirement is practically as rigid as that for cut stone

joints in building construction. It is not a practical proposition to split out paving blocks so that a ⅜ in. joint can be rigidly complied with. If a cement grout filler is used such a joint is not necessary, and it is very questionable if it is ever necessary with even a bituminous filler. It certainly is not desirable to specify something which it is not practicable to obtain.

Other Variations from Standard.

Other variations from the standard are so-called 4 in. blocks, Durax blocks, and the like. It is sometimes necessary, because of freight charges, etc., to use shallow blocks, or else use a pavement which is less durable than granite blocks. This condition is more likely to prevail on road work and in inland cities where there is a rail haul.

Then there is another condition which requires a shallow block, and that is where the traffic conditions have changed so much that it is necessary to use granite to replace a lighter material, and yet it is desired to utilize the old concrete foundation. For such a condition a resurfacing block is made which has a depth of 3½ to 4 in. It is preferable to lay such a block upon a cement mortar cushion, especially if the traffic is heavy.

CONSTRUCTING THE MODERN GRANITE BLOCK PAVEMENT (LEFT TO RIGHT): MIXING BITUMINOUS FILLER AND SAND—POURING BITUMINOUS FILLER—GROUTING GRANITE BLOCK PAVEMENT—PILE OF WELL CUT GRANITE PAVING BLOCKS.

Laying the Pavement

The standard block when properly cut and laid is the most suitable for general conditions. This pavement is laid in various ways. In cities and localities where it is possible to block off traffic for a sufficient time to permit the use of a cement grout filler, it is usually laid with such a filler, and if the traffic is heavy enough to warrant the expense, it is often laid on a cement mortar cushion mixed in the proportion of one part of cement to three or often four parts of sand. This makes a very solid and durable pavement when properly done. The blocks should be sorted and laid in courses so that blocks as nearly as possible of the same width are in a course and the blocks should be paved with close end or longitudinal joints, the courses running transversely from curb to curb. The transverse joints should be as close as possible and yet keep straight courses. The longitudinal joints should be broken by a lap of at least 3 inches.

Ramming

The pavement should be thoroughly rammed and all poorly bedded blocks raised and back rammed until the blocks are all well and evenly bedded and the surface of the pavement is true and even to the grade and crown of the street. It is advisable to use no sand or gravel in the joints. Proper ramming will cause the blocks to sink into the cushion so that a little ridge of the cushion will separate the blocks and be sufficient to hold them until the filler is poured, provided wheeling and other traffic is not permitted over the surface.

Cement Grout Filler

Now the pavement is ready for the filler. If it is to be a cement grout filler, it should be mixed in the proportion of one part of Portland cement to one part of fine sand, preferably an even-grained sand, and when possible to obtain it, without excessive cost, one which will pass a 20-mesh sieve. The finer and more even the sand particles the better they will remain in suspension and make a uniform filler. A machine mixer should be used in order to secure a uniform product and the grout should be delivered directly upon the pavement by means of a chute or spout. The grout should then be broomed into the joints thoroughly until they stand full and flush with the surface of the blocks, but a surplus should not be left over the surface. The wear should come upon the granite. The traffic will then wear down any small irregularities in the heads of the blocks.

Bituminous Filler

When a bituminous filler is used the best practice is to add a fine hot sand and mix it before pouring the joints. A straight coal tar pitch is too susceptible to temperature

changes to be used in this climate, but a mixture of one part of asphalt with five parts of coal tar pitch gives good results, as does also an asphalt filler. With either of these there should be added not to exceed 50 per cent. by volume of fine sand similar to that used in a cement grout filler. The amount of sand added should be at least 35 per cent. The sand should be mixed into the hot bituminous material and then drawn off into wheelbarrows or the like and dumped at once upon the pavement. It can then be worked into the joints by means of hoes or the like. When the joints are thoroughly filled so that they stand up flush with the surface of the blocks, then a small amount of sand should be spread over the surface. This will prevent traffic from sticking and will help to harden the surface of the joint filler.

New York Practice

Brooklyn, N. Y.; uses a mixture of coal tar pitch, 100 parts; refined residual asphalt, 20 parts; to which, after thorough mixing, is added not to exceed one part of sand to one part of this bituminous mixture. The sand is fine, passing a 20-mesh sieve, and is stirred in usually by a mechanical mixer.

In the Borough of Manhattan one part of hot asphalt cement is mixed with not to exceed one part of sand, the latter to pass a 10-mesh sieve. The mixture is made in a concrete carrier or pushcart of about 7 cu. ft. capacity. The mixing is done with a rake or a perforated hoe. Both here and in Brooklyn the hot bituminous mixture is dumped directly upon the pavement and is pushed into the joints by means of hoes or squeegees. These forms of bituminous fillers give the best results for this class of filler. Bituminous fillers are most suitable for use when the traffic conditions are such that it is not practical to block off the street a sufficient time to permit the proper setting of a cement grout filler.

Cushion Course

The cushion course on top of the concrete is usually sand and it should not be greater in depth than an average of 1 in. This is sufficient with a specification allowing only a maximum variation of ½ in. in the depth of the blocks. Of course, the surface of the concrete should be smooth and it should conform to the crown of the finished pavement.

In some localities a dry mortar cushion of one part cement to four parts of sand has been used with success, especially where the joint filler was cement grout. This makes a very rigid pavement, and where the traffic warrants the additional expenditure of about 15 cts per square yard it is probably advisable. The mortar cushion has been used also with a bituminous filler, but this seems to the writer to be a useless expense, as the traffic is allowed on the pavement before the cushion can obtain a proper set, and an examination of many openings has failed to show him a case of a bond between the bottom of the block and the mortar cushion. The claim is made that this cushion does not wash if any water finds its way through the joints of the pavement. If the joint filler is properly placed in the joints there should be no trouble from this source, even with a sand cushion. With a cement grout filler the blocks are held rigidly and the cushion obtains a proper set as the traffic is blocked off in order to permit the grout to set, and the cushion has the same opportunity.

Recent Improvements in This Type of Pavement

Even with the great strides which have been made in granite block pavements in the past half a dozen years, there are still a great many people in our cities who picture the old style rough, open-jointed granite pavements when they hear granite mentioned in connection with pavements. As a matter of fact these same people will ride over the modern smooth surface granite block pavements laid with cement grouted joints or with the latest form of bituminous joints and not recognize that it is a granite block pavement and consequently fail to give it the credit which is its due.

The modern granite blocks, when properly laid, make a pavement which is as near permanent as it is possible to lay, and which is smooth and yet not slippery. While it is not wholly noiseless under metal tire traffic, yet because of its smoothness and the fact that the percentage of this kind of traffic is getting smaller and smaller each year, it is rapidly becoming a noiseless pavement.

The great improvement in the surface and the joints of this pavement in recent years has been due wholly to the cooperation between the engineers and the granite quarrymen. They have worked together in the endeavor to produce as good a block as it is practicable to make on a commercial scale, and then having these blocks paved better and closer than formerly and then really filling the joints with more permanent kinds of joint fillers. Neither the engineers nor the quarrymen could have accomplished this alone, but both working together with the same goal in mind resulted in great improvements in granite block pavements in a comparatively short time.

Acknowledgment

The foregoing discussion is from a paper by Mr. Pollock before Section D, Engineering, of the American Association for the Advancement of Science.

WATER WORKS DESIGN AND CONSTRUCTION

Breadth of View in Water Works Design

By John W. Alvord, C. E., Hydraulic and Sanitary Engineer, Chicago, Ill.

A good story is told about a medieval walled town which was undergoing a long and severe siege in which, the military men being largely killed off, the citizens were finally called together for a council of war. Many suggestions were made for driving off the enemy. Finally the town shoemaker arose and solemnly suggested that it was his judgment that a large number of extra heavy iron-tipped brogans should be made immediately and a given number of citizens so equipped go out and kick the enemy to death.

Breadth of View Comes from Familiarity with Many Plants

In water works design it is often true not only of the layman, but also the engineer, that his projects bear the stamp of a limited breadth of view. Engineers familiar with only one type of water works often drag in their "brogans" to every situation, regardless of applicability. Engineers who have grown up with a single large water supply sometimes find themselves curiously helpless when they are confronted with small-town plant design, and, conversely, those who have only built small plants often find it difficult to think in large unit quantities when occasion unexpectedly arises. Again, men who are skilled in load factors and stresses only oftentimes fail to grasp economic problems, and finally the all too

general suspicion of the laymen administrators who employ the engineer is that he does not always exercise business judgment in addition to his technical information.

The remedy for all this is obviously breadth of view.

Breadth Comes with Occupational Maturity

Breadth of view is acquired by experience, by constant and persistent study, by travel, with engineering information as a prime objective, but most of all it is acquired by what may be called occupational maturity, not necessarily the maturity of white hairs, but the maturity of long continued and concentrated attention centering around a given subject, but not limited to it alone.

It is one of the misfortunes of youthful designers that capitalists, and in fact almost all administrative bodies with any deep sense of their responsibilities, want as much experience and maturity as they can get for the money they can appropriate for engineering service. The underlying reason for this is sound, though not always pleasant to endure. Men with money to spend want to know that it is expended wisely, and they have an instinctive feeling that a certain kind of maturity is at least one of the requisites of wise expenditure.

Value of Experience on Small Works

It has been said that a large proportion of our great bankers are educated in the small towns, where the opportunities have been afforded them to become personally familiar with every phase of the banking business. Likewise the young water works engineer can usually accumulate a broad, valuable information more rapidly on engineering problems relating to a considerable number of small plants, for the engineering and economic problems of such plants are quite as exacting and often require more ingenuity and good judgment than problems on large works. In a given length of time the practitioner on a series of small plants will usually be engaged upon a greater variety of undertakings, and will become familiar with a large number of conditions, equipment and devices, than will engineers who have been devoting themselves to a single large task.

Acquaintance with All Available Devices Is Requisite

There is scarcely a water works device upon the market or a form of general design that is not most applicable to some particular set of circumstances in the water works field. No technical or mathematical ability can take the place of an intimate acquaintance with all the available devices capable of accomplishing a certain purpose, and the characteristics of equipment that make it applicable or economical in one situation and less desirable in another.

This ability to surround his subject, to get everything into the proper perspective, and to look at it from all points of view, is a quality notably lacking in the layman, the so-called practical water works man, and even many engineers of only limited experience.

Complete Study of Water System Necessary

The engineer must have an analytical type of mind in order to acquire this proper perspective. He should not permit the real problem and its proper solution to be hidden by improper limits placed upon his investigation by clients who are often groping in the dark. In ordinary practice the engineer is frequently employed to plan a specific remedy, such, for instance, as drawing specifications for new pumping equipment, an addition which, perhaps, in the guess of some alderman, should insure a plentiful water supply. The experienced engineer often finds it necessary, after beginning his work and gaining some insight into the problem, to have his assignment radically changed, resulting, perhaps, in measures and remedies quite different from what was at first taken for granted as necessary. Procedure like this is the rule rather than the exception.

It is usually found that what is really needed is a complete study of the water system. Only by such general study of a water works plant, periodically made, can expenditures be wisely governed, so that each improvement is a part of the well-designed and balanced growing property, and investments thus made be not superseded in the future.

Fundamental Municipal Conditions Vital Factors

In the broader aspect of the design of water works structures, fundamental municipal conditions are often vital factors, and a close scrutiny of the past service and its deficiencies is necessary to determine the direction in which territorial expansion may take, the industrial prospects, local peculiarities, habits and the increasing needs of a growing population. These and other like matters are always interesting and important questions.

Designer Needs Prophetic Vision

It is almost always necessary for the designing engineer to become, in a sense, a sort of prophet, for he must design for the future, not for the past, or even the present, exclusively, and, therefore, the probable future conditions must be determined as accurately as is possible if the design shall fit the growing needs. This requires an intimate water works experience with a wide variety of conditions, and the judgment in these matters is greatly aided by a review of the past growth, not only of the plant in hand, but of many other similar plants. The gift of second sight is not required of the engineer, but this does not excuse him from determining as well as he can the most probable coming occurrences that affect his design.

Provision for the future does not necessarily involve present expenditures only useful a long time hereafter; on the contrary, it is one of the fundamentals of sound design that the immediate future shall not be overburdened with cost to provide for possibilities which may never develop precisely as expected, or which can be better financed when the needs are more fully disclosed. If the designer has correctly read the most probable future necessities, it usually happens that the design can be made capable of progressive expansion, so that it will permit the ready care of future requirements when they are fully apparent, without curtailing or destroying the value of past investments. This, again, can be accomplished only when ripe experience has been brought to bear on the problem.

Design Reflects Maturity of Designer

Every completed and operating water works plant writes the story of its designer's mind, experience and maturity, but it is a story that cannot be read by the uninitiated. The experienced water works designer visiting a plant for the first time reads with a keen interest the study of its original designer, and observes where he looked into the future and looked correctly. The intelligent observer of a record of this kind will not be filled with cheap or carping criticism, for he knows too well that foresight is more difficult than hindsight, but he will be pleased when he discovers that his predecessor was intelligent, thoughtful, experienced, and prophesied clearly and correctly, for that is nothing short of breadth of view.

How important breadth of view can be in emergencies is well seen in the recent cantonment construction for the U. S. Government. The supervising engineers locally employed at each cantonment each received a typewritten copy of general instructions from Washington, framed up by water works engineers of ripe experience and outlining the general intent and policy of the works to be constructed. So complete and well thought out were these instructions that no question remained to be asked, and modification to suit local conditions in each case was all that was necessary. Only those who entered the desperate race against time, which the building of these temporary cities involved, could realize how large was the saving of time and the avoidance of delay by this wisely matured forethought.

Rivers as Sources of Water Supply

By Robert Spurr Weston, of Weston & Sampson, Consulting Engineers, 1¼ Beacon Street, Boston, Mass.

Three main sources of water supply are in general use—namely, wells, lakes and rivers—and of these rivers are of chief importance in the United States, where, as a rule, abundant ground water supplies are not located near large centers of population, and although many cities, like on the Great Lakes and in the northern tier of states, draw abundant supplies from lakes, the vast majority must turn to the many large rivers, usually abundant in the most populous parts of the country.

It is universally agreed among sanitary engineers that most river waters—excepting perhaps mountain brooks and the like—are unsafe for drinking purposes unless purified either by long storage, filtration or sterilization.

Purification by Long Storage

Purification by long storage was the first method employed. The employment of this means of purification was largely adventitious because storage for quality was only an attendant circumstance of storage for quantity. As early as 1890 it was generally recognized by sanitarians that cities which used stored water from sparsely populated drainage areas, or which drew their supplies from deep wells, suffered less deaths from typhoid fever than cities taking water directly from rivers, or indeed from lakes at points which were occasionally contaminated with the city's own sewage.

Among the best supplies were the impounded Croton, Sudbury, Saugus, Hobbs Brook and Passaic Rivers, supplying the cities of New York, Boston, Lynn, Cambridge and Patterson. Among the worst were those supplying the cities of Birmingham, Denver, Allegheny, Camden, Pittsburgh, Lawrence, Newark and Lowell, with sewage polluted water pumped directly from rivers. Many of these impounded supplies, with improvements and additions, are still as safe and of as good quality as any, and the typhoid fever death rates in New York and Boston are among the lowest in the United States.

Reduction of Typhoid Due to Purification and General Sanitation

It has not always been possible or economical to secure an impounded supply of sufficient volume and many cities have been obliged to use water from rivers. Before 1890 most of these waters were used without long storage or purification. Recently most cities have adopted some method of purification involving filtration, or have at least sterilized the water with chlorine. The use of these purified waters has been attended with great success and typhoid fever in such cities as Pittsburgh, Cincinnati, Philadelphia, Albany and Lawrence, has been reduced to below what sanitarians, writing as late as 1905, predicted would be the minimum when the water supply had been purified to the practicable limit. To use the technical phrase, purification and general sanitation have reduced the typhoid fever death rate far below the "residual typhoid limit," and as a result the typhoid fever death rate in many American cities is as low as that in some European cities noted for their low rates. Some of the striking reductions are given in Table I.

Therefore it has been proved statistically that river waters may be so well purified that the protection afforded the drinker will be as good as that afforded by the use of pure ground water, an impounded upland water or a pure natural lake water.

Rivers Must be Used

It is obvious that problems of water supply are problems of concentration of population and that hand in hand with the problem of water supply is joined the problem of pollution. Water borne infection is nothing more nor less than transferring disease producing bacteria from the anal end of one intestine to the oral end of another. By inspection or control of the river drainage area, it is not practicable to prevent entirely this transfer. Furthermore, rivers attract population, and population demands disposal of sewage as well as water supply. On some industrial rivers, the prohibition of pollution would so hamper industry that manufacturers would be forced either to go out of business or move away. Consequently many rivers must necessarily be used for manufacturing, drainage and municipal water supply. Others may become unfit for water supply and be relegated to drainage and manufacturing uses only. Each stream, in other words, must be used for the best interests of all riparian owners and with due regard to the rights and convenience of all.

Table I—Reduction in Typhoid Fever Death Rates in American Cities Following the Purification of their Public Water Supplies

City	Average Typhoid Fever Death Rate Before Filtration	After Filtration	Percentage Reduction
Albany, N. Y.	109	28	74
Cincinnati, O.	56	11	80
Columbus, O.	83	17	78
Lawrence, Mass.	110	23	79
Patterson, N. J.	29	9	69
Philadelphia, Pa.	63	20	68
Pittsburgh, Pa.	132	19	85
Scranton, Pa.	25	10	60

Impracticable to Use Some Rivers

In highly polluted and contaminated streams, dilution alone cannot be relied upon to make the water fit even for purification, and in these cases sewage has to be purified before discharge. Some streams are so small and so highly polluted that it is impracticable to use them for water supply. Such streams are the lower Blackstone and the lower Passaic. Even the water of the lower Merrimac, now used for the supply of the city of Lawrence, is difficult to purify on account of pollution with sewage and manufacturing waste.

Self-Purification of the Mississippi River

The great Mississippi River, however, serves as a source of water supply for cities, and serves as a drainage channel for all or part of 31 States. It is polluted and then repurifies itself naturally, or the sewage discharged into it is purified artifically, and the river below is used with impunity after repurification by artificial methods. Notwithstanding this extensive use of the river for all purposes, the dilution is large and the opportunity afforded for self-purification adequate. Consequently the river at New Orleans, while burdened with the mud of a dozen States, is only slightly polluted with disease carrying bacteria. Many kinds of water make up the Mississippi. There is the clear water from the lakes of Minnesota, Wisconsin and the North; the slightly turbid water of the Allegheny; the hard water of the Monongahela; that of the moderately turbid and moderately hard Ohio; the colored and slightly turbid water of the upper Mississippi; the muddy water of the Missouri; the hard, alkaline, turbid Arkansas water; the peaty, highly colored Yazoo water, and that of the Red river, with its burden of ochre colored suspended matter, all joining above New Orleans to make the turbid, moderately hard flood which rushes to the sea.

It is obvious that efficient sewage disposal is necessary in the upper branches of this river system, but farther down, where the dilution is greater, the methods need not be so refined, while in the main river its dilution alone is more

than ample to prepare the diluted water for treatment by ordinary water purification methods, and the removal of the mud by coagulation necessarily produces a hygienically safe water.

Characteristics of the Thames River

Entirely different from the lower Mississippi is the English river Thames. Probably no river has been studied more thoroughly. Prominent among those who have investigated it are Wanklyn and Frankland, Dibdin, Rideal, and, more recently, Dr. A. C. Houston, Director of Water Examination of the Metropolitan (London) Water Board.

The Thames is a small stream, carrying slightly turbid, moderately colored and slightly polluted water. It lies entirely in England; it has a drainage area of 6,000 square miles and a length of only 210 miles. At its source it is 370 feet above sea level and flows into the North Sea with an average slope of 1.75 ft. per mile. With this slope, average velocities of as low as 0.25 mile per hour occur in September, and as high as 4.5 miles per hour in February. It is evident, therefore, that conditions favorable for self-purification exist in this stream, and notwithstanding the fact that it drains a populous country, contributing raw and imperfectly purified sewage to the stream, London has enjoyed a typhoid fever death rate far below that of any American city, and, in fact, below that of most European cities, notwithstanding the low efficiency of the filters, especially in former years. As 60 per cent. of the supply comes from the Thames and 20 per cent. more from the River Lea, it is obvious that London consumers are supplied with a hygienically safe water. So great are the factors of dilution, sedimentation and the antagonism of other organisms that disease bacteria do not survive very long or reach the intakes of the various works reduced in vitality. Houston has stated that there was little to choose in favor of an intake 55 miles above Hampton as compared with the existing one at Hampton.

Purification of Thames Water

The Thames water is purified by storage, followed by filtration through slow filters. Storage alone for about 15 days in the Chelsea reservoirs removed 95.3 per cent. of the bacteria growing on gelatine, and practically 99 per cent. of the B. coli. Similar, though not so great, reductions were obtained in other reservoirs. Not only does storage remove disease bacteria, it also devitalizes them. Storage has also other practical and well-known advantages, such as flexibility of supply, decoloration and clarification of water, and it prolongs the period between filter cleanings. The filtration of the stored water still further purifies the supply, and in London the total bacteria are reduced in the filtered water to less than 1 per cent. of those in the raw water, while the filtered water contains less than one-thousandth of the B. coli present in the Thames water at the intake.

Sterilization

Another purification method is sterilization. This has been largely developed during the last five years. Two reagents are of practical use, namely, lime and chlorine. It was discovered that the lime used to soften water effected a marked reduction in bacteria. Houston has shown that this is due to an excess of caustic lime in the water, and he has applied the principle in practice, notably at Aberdeen, where a soft water was treated successfully with only 10 parts of CaO per million at a cost of less than 20 cts. per 1,000 U. S. gals., and at Sunbury, where the Thames water was disinfected with about 200 parts of lime (CaO) per million. In the latter case treatment, followed by slightly more than a day's storage in tanks, removed 76 per cent. of the color and 99 per cent. of the bacteria. Similarly striking results of this "excess lime" treatment have been observed at New Orleans, Columbus and other American softening plants.

Sterilization by Chlorine

Sterilization by chlorine is now too well established a practice for comment. The dramatic demonstrations of its efficiency at Bubbly Creek and Jersey City, by G. A. Johnson, have been followed by careful study and experiment and the use of the convenient liquid chlorine in place of bleach. At present the method may be depended upon to make safe any clear, low-colored water. However, it is not a substitute for filtration or storage in most cases, but a supplement thereto.

It is now generally admitted that river waters may be purified to any necessary degree. In some cases the simple removal of suspended matter by coagulation and rapid filtration, or a month's storage, is all that is necessary; in other cases the softening process, and again others the applicaton of a minute dose of chlorine guarantees safety. Even quite highly polluted streams may be made safe if the discharge of unpurified sewage be minimized.

Rivers Economical Supply Source in War Time

With the methods—storage, chemical treatment, filtration and disinfection—so well developed, and with sewage disposal to make the raw water clean, there are but few rivers in existence which cannot be made safe for domestic and dietetic purposes, although there are many streams which might be objectionable for aesthetic and psychological reasons. Therefore, when considering water supply problems, especially in war time, when the strictest economy is imperative, the apparent superiority in quality of the usually expensive distant lake or impounded source should be scrutinized with careful comparison with the usually cheaper and equally safe river supply from near at hand. Again, although the number of unsafe supplies is rapidly decreasing, many cities have abundant supplies of unsafe river water. In many of these cities, the old supply is abandoned when by purification it could be utilized with safety and satisfaction for years to come.

Conclusion

In conclusion, the writer will state that most river waters may be used as sources of water supply with dependable safety if purified by modern methods; and there is, in most cases, little reason to choose more expensive supplies from other sources for fear that the river supplies cannot be made agreeable and perfectly safe.

REFUSE COLLECTION AND DISPOSAL

Operation of High Temperature Incinerator Plant at Savannah for Three Years and Nine Months

By E. R. Conant, Chief Engineer, City of Savannah, Ga.

(The Destructor plant at Savannah is one of the very few in the country that gives such high credit for by-product steam. Since the commencement of the operation of this plant, no objection whatever has ever risen from the people. It has been operated in such a manner that there has been no obnoxious odor or unsanitary conditions from which a complaint could emanate.—Editor.)

The December, 1914, number of MUNICIPAL ENGINEERING

contained a description of the high temperature refuse destructor at Savannah, which was completed and put in operation on April 1st, 1914. It has been in continuous operation since then, and so many inquiries are received concerning the operation of the plant, that the writer thought it might be interesting to those interested in refuse disposal to learn what success Savannah has experienced with its plant, of which there are only a limited number in the United States. This is a high temperature destructor of the Heenan-Froud type and was constructed by the Destructor Company of 11 Broadway, New York City. It was completed in March, 1914, and only accepted after necessary tests were made to make sure that all guarantees made by the company were fulfilled.

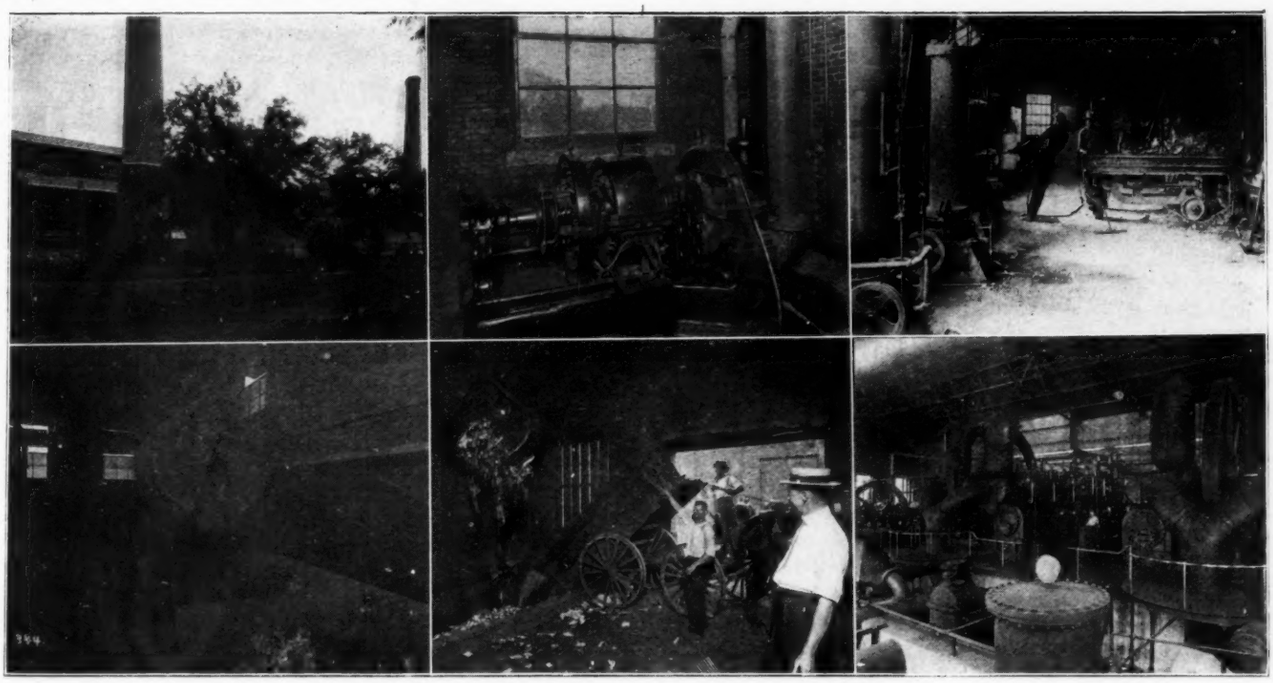
Brief Description of Plant

The plant has a rated daily capacity of 130 tons of mixed refuse. This refuse consists of household, hotel, and restaurant garbage and rubbish collected from households, stores, and a certain portion of ashes from households, but not from manufacturing plants. Street sweepings and carcasses of dead animals are not destroyed, but are sold for revenue. The plant is of two units, with four cells to each unit. The refuse is dumped into a large hopper at the ground level, raised with Haywood buckets and carried to containers over the furnace by an electrically operated crane. The plant is only semi-mechanically operated. The clinker is withdrawn with hydraulic rams and the doors over the furnace are opened and closed likewise. No fuel is used other than refuse in consuming the refuse. There are two boilers, each unit of 330 horse-power. Steam is generated by the heat coming from the hot air and gases carried from the furnaces. The steam generated in the boilers is carried to the electric generator, which furnishes the power for the electrically operated equipment of the plant and any excess steam is conveyed direct to the boiler header in the water works pumping station, located about 100 ft. from the Destructor plant.

Amount of Refuse

Reference is invited to MUNICIPAL ENGINEERING of December, 1914, for a more complete description of the plant. The plant has been in continuous operation from April, 1914, to this date, a period of three years and nine months. During this period the total consumption of refuse was 98,717 tons, equivalent to 72.6 tons per day.

Under normal conditions the refuse is approximately of the following character and proportion: 40 per cent, in weight, which might be classed as garbage; 45 per cent rubbish; 5 per cent sweepings from stables; and 10 per cent ashes. However, during two months of each year, July and August, we have an unusual condition existing, in that there is a daily collection of from 15 to 20 tons of almost pure watermelon and cantaloupe rinds, or waste melon. The average daily consumption for these two months of each year, is 100 tons per day. In order that this additional percentage of garbage, which is very wet, can be consumed, it is customary to add from 10 to 12 tons daily of manufacturing cinders or ashes, which has been collected during the winter in piles outside of the Destructor Plant. This has been practically the only fuel required in order to destroy this extremely wet garbage.



VIEWS OF REFUSE DESTRUCTOR, SAVANNAH, GA., IN SUCCESSFUL OPERATION FOR NEARLY FOUR YEARS.

Left to Right—Exterior View of Destructor and Water Works Pumping Station—Turbo—Generating Set for Supplying Current to Cranes—Front View of Furnace Showing Power Method of Withdrawing Clinker—Feeding Platform—Receiving Floor —Main Water Pumping Station Utilizing Steam Produced by Destructor.

Experiments With Soft Coal and Wood Fuel

In 1917, in order to increase the amount of steam, it was deemed advisable to experiment with burning a small amount of soft coal and wood, and the expenditure for the two months of this year in which this experiment was made amounted to perhaps $300, which resulted in a greater saving of fuel at the Destructor Plant and its use was fully warranted.

Deducting the amount of refuse destroyed during these two abnormal months, the average daily consumption for the remainder of the period of three years and nine months, was 66 tons, which is really the quantity that produces the excess steam, which will be referred to later.

War Reduces Refuse Production

The household saving for the year 1917 is shown by the reduced amount of refuse collected during this year over preceding years. As every pound of refuse taken to the Destructor Plant is carefully weighed, we have accurate record of the saving brought about due to the war situation. To

compare the saving it is proper to deduct refuse collected during July and August, for if anything during the watermelon season this year, there was a greater consumption of this cheap article of food over the preceding years.

Taking ten months of this year and comparing same with ten months of 1915 and 1916, it is noted that the daily collection for this period for 1917 was 60 tons, 1916 was 66 tons, 1915 71 tons, 1914 for seven months 73 tons.

Expenditure Made in Destroying Refuse for Three Years and Nine Months

Operation:		
Labor	$61,506.00	
Material	6,101.00	
Total		$67,517.00
Maintenance:		
Labor	$ 1,200.00	
Material and repairs, including labor and material	7,967.00	
		$ 9,167.00
Outlays	$ 2,596.00	
Clinker disposal	5,091.00	
Weighing of refuse	3,199.00	
Handling cinders for fuel during July and August, each year	1,900.00	
Fuel purchased	500.00	$13,286.00
Grand Total		$89,970.00

Credits on Operation

Amount of coal used as fuel at Pumping Station is carefully weighed daily. The value of steam turned over the Waterworks, is determined by deducting the amount of fuel actually used from the amount that would be required for pumping water, if there was no auxiliary aid furnished. It has been determined that the saving in fuel for the nine months of 1914 was $5,933, for the year 1915, $6,562; for the year 1916, $5,529, and for the year 1917, $7,500, making a total saving of fuel for the three years and nine months $25,524. The increased saving in 1917 is due to the high cost of coal.

The amount of clinker removed during the three years and nine months is approximately 25,000 tons. The cost of removing clinker was 20 cents per ton. A certain amount of this clinker was sold and a certain amount used for filling holes in suburban roadways or for hardening roadways. The credit value for this was $3,000. The remainder of this clinker was used in filling in land, which greatly enhanced its value and a credit of $1,963 is giving for this filling, so that a credit for clinker should be considered equal to the cost of removing it.

Credit is also given to outlays enumerated in a total cost amounting to $2,596 and for material on hand at the end of year valued at $3,000.

Summary of Credit

Steam	$25,524.00
Clinker	4,963.00
Outlays	2,596.00
Material on hand	3,000.00
Total	$36,083.00

Deducting this from the total expenditure noted leaves a net cost of $53,887, or a net cost per ton of 54.6 cts. The guaranteed net cost of operation, assuming that the plant is worked to its capacity of 130 tons per day is 40.4 cts. per ton. As noted with the exception of July and August of each year, the consumption is only 66 tons per day. Any increase over 66 tons, would materially increase the amount of steam furnished the pumping station, for at 66 tons there must be enough steam to operate the Destructor Plant and anything over the amount required would be a saving, so that if the plant was operated at its full capacity the cost of destroying refuse would be below the guaranteed cost of 40.4 cts. per ton. During the months of July and August, when the garbage is so very wet, there is practically no steam turned over to the pumping station.

Plant Has Made Good.

The official tests at the time the plant was accepted showed that no odor of obnoxious gases escaped from the building, that the temperature in combustion chambers exceeded the guarantee and that the steam generated exceeded that required. The three years and nine months period that it has been operated prove its success and show that the plant equals the performance guaranteed by the builder and expected by the purchaser.

The costs given do not include interest on investment nor depreciation. It must be recognized that destroying a city's refuse by incineration is an expensive method, but at the same time it is the most sanitary and hygienic method known. The character of the refuse in the Southern cites is different from that of the cities in colder climates. The garbage portion of the refuse is less here than in northern cities and the quality of that collected is insufficient to warrant the adoption of the reduction process. There is every indication that under existing war conditions the feeding of garbage to hogs is a feasible method of utilizing this portion of the city's refuse, and consideration is being given in this city to separate collection of that portion of the garbage suitable for feeding to hogs to be collected and used in this manner.

SEWER DESIGN AND CONSTRUCTION

Some Practical Hints on the Design and Construction of Sanitary Vitrified Pipe Sewers

By Charles E. Collins, Consulting Civil and Hydraulic Engineer, Drexel Building, Philadelphia, Pa.

The present article is intended to cover only some of the more important parts of the design and construction of sanitary vitrified pipe sewers. In designing sanitary sewers probably the most important part is a careful study of all the conditions having a bearing on the sewers or system of sewers to be designed. To be able to make such a study the designing engineer should have an accurate survey of the area to be covered.

Accurate Survey

This survey should include accurate profiles of all of the streets, elevations of the ground at a sufficient number of points between the streets, so that a contour map may be prepared of the total area to be covered by the sewer system, the elevation and location of the lowest cellars or basements in each block, the location in plan and elevation of underground structures in the streets, the location of watercourses, street railway tracks, streets and alleys.

Where there is any doubt whether rock will be encountered, or where it will be encountered and the depth below the surface of the street cannot be ascertained from the data at hand,

borings should be taken at sufficient points to enable the engineer to make an approximate estimate of the amount of rock to be excavated from trenches.

As the number of persons within a certain area in different parts of the city will vary, memoranda should be made in the field notes showing density of population for different sections of the city, also manufacturing and business sections, the amount of water per capita per 24 hours at different seasons, whether meters are used, and if only part of the system is metered give percentage of metered connections to total connections, also relation to gallons used, the number of persons served and amounts used for manufacturing purposes, the present population and the increase in population each ten years for the total number of years covered by the records. The above covers briefly and in a general way the most important data that is included in the survey.

Map and Profiles

After this data has reached the office it is the writer's practice to have a general topographic map and profiles prepared of the entire area to be covered, an estimate made of the number of persons to be served and the amount of sewage and ground water that will be contributed by the various parts of the system. Referring to the field notes, we find the areas covered by the different degrees of density of population, from which we readily determine the population per unit of area, or unit of frontage, on the sewer line for all built-up sections.

Estimating Population to Be Served

The field notes also give the classification for different degrees of density of population under which undeveloped land should be placed, so that the future population may be determined fairly accurately from these areas, using the same population per unit of area or frontage as exists in the built-up section for the same classification. In doing this, however, approximate street locations must be assumed through vacant lands so as to determine into which sewers the assumed volume of sewage will flow. In determining the location of these proposed streets the writer has used the same distance between street centers as existed in like areas in the built-up section, and while the undeveloped land has not in many cases been divided as assumed, yet the amount of sewage contributed to the sewers as designed and constructed has agreed almost exactly with the amount assumed.

It must be remembered, however, that this assumed future population is for the area after it is fully built up, and therefore must not include areas too remote from the developed section. To estimate the future population of a city requires a careful study of each problem, giving due consideration to its location, conditions and past growth.

In estimating future population the writer uses a curve made up from the average increase in population of several larger cities, starting at a point where each had approximately the same population as the city under consideration. These cities should be selected from locations similar to the location of the city under consideration and the general conditions that have had the greatest bearing on the growth of these cities should also be similar to the conditions in the city for which the estimate of population is being made.

Amount of Sewage per Capita

Having arrived at an estimate of the future population, the next step is to estimate the amount of sewage per capita. Where possible gaugings should be taken of the flow of sewage from the section of the city to be sewered and the rate per capita based on these measurements, provided in the judgment of the engineer this measurement seems to be within reasonable limits. I believe a reasonable limit is between 65 and 100 gals. per 24 hours per capita connected with the sewers, which should include all house sewage, water used for flushing sewers and small manufacturing wastes, but should not include ground water nor waste from large manufacturing plants. If no reliable measurements can be taken of the amount of sewage, it must be based upon the amount of water used after allowing for the increase that will result from the use of a complete system of sanitary sewers. The writer has usually found that if the water consumption amounts to from 70 to 100 gals. per capita, 80 per cent. of this amount is a fair estimate of the amount that will reach the sewers. If the amount is less than 70 gals. per capita per 24 hours, it is best to assume that it will reach this amount later. If the amount of water used is in excess of 100 gals. per person per 24 hours, after deducting the amounts used by large manufacturing plants, I believe it is due to unnecessary leakage, of which at least 50 per cent. of the amount over 100 gals. is through defective joints in the mains and would not reach the sewers; therefore, if the records show that more than 100 gals. per capita per 24 hours is being used, at least 50 per cent. of the amount over 100 gals. should be deducted before taking 80 per cent. of the amount used as the amount that will reach the sewers.

Ground Water Infiltration

The amount of ground water will depend upon the length of sewers exposed to ground water, the head of ground water on the sewers, the kind of joints and workmanship in making them. There is a seasonal variation in the head of ground water in the sewers and of the length of sewers exposed to ground water in every system. In some systems practically the entire length will be under ground water at certain seasons and at other seasons there will be but very little or no ground water above the sewers. The specifications should be drawn so as clearly to specify the kind of joints to be used and the method used in making them. The workmanship in making joints will vary under different engineers and inspectors, so that there will be a wide variation in the amount of ground water entering the sewer under the same conditions, depending upon the engineer and inspector having the work under their direction, and while the experience of other engineers is valuable, I believe each designing engineer should base his estimate of the amount of ground water to be taken care of largely upon his personal experience.

Weir Measurements of Infiltration

The writer recently made careful weir measurements of the amount of infiltration of ground water into a system of sewers constructed under his supervision, consisting of about 27 miles of vitrified pipe sewers, varying in size from 6 to 36 in. in diameter, and in trenches varying in depth up to 32 ft., and in some instances the sewers were laid in wet ground and in fine running sand. The measurements were taken in the spring after heavy rains, following the construction of the system, and before connections were made with the houses. The flow of ground water from the sewers reached a maximum of 216,000 gals. per 24 hours, or about 8,000 gals. per 24 hours per mile of sewer. With American Portland cement joints, one of sand to one of cement, and first-class workmanship, the infiltration in vitrified pipe sewers should not exceed 10 per cent. of the estimated amount of sewage when the ground is at its maximum elevation. The necessity of employing only skilled and absolutely reliable workmen under rigid inspection on this part of the work should not be overlooked if the best results are to be accomplished. I believe the use of quick-setting cement in wet ground also reduces the amount of infiltration and under very bad conditions it is on the side of economy to use a first quality sewer pipe joint compound.

Maximum Hourly Flow

After the engineer has carefully estimated the amount of sewage per 24 hours per capita, including infiltration, he should determine upon the maximum hourly flow. Unless there is some unusual local condition having a direct bearing on the maximum hourly flow the writer uses one and one-half times the average flow and designs the sewers so that when

receiving the maximum hourly flow the sewers will not flow more than two-thirds full.

Location, Size and Grade

Having determined upon the maximum hourly flow, the next step is to determine on the locations, elevations, grades and sizes of the sewers. When practical it is preferable to locate the sewer in the center of the street and at such an elevation as will drain all basements. Minimum grades should, as far as possible, be limited to those that will produce a flow of 2 ft. per second. With the aid of the topographic map and profiles, on which should be indicated the elevations of the lowest cellars within each block and the elevations of the surface of the rock, the engineer should, after a careful study of all the conditions having a bearing on the design, be able readily to determine locations, sizes and depths below the surface of all lateral sewers, then the most economical location, size and grades of the intercepting sewers, finally bringing all into one main intercepting sewer terminating at the disposal plant.

Information on Maps and Profiles

The topographic map should be drawn to a convenient scale and should show the general plan of the system, on which should be marked in figures the elevations of the sewer at all manholes, flush-tanks and changes of grades; also the sizes and rates of grade of all sewers should be shown in figures. The profile sheets should show a plan and profile of each street drawn to a scale that will clearly show the depth of the sewer below the surface and on which should be marked in figures the elevation of the sewer at all manholes, flush-tanks and changes of grade; also on the profiles should be marked in figures the sizes and rate of grade of each sewer. The writer has found the most convenient size of these sheets for profiles to be about 10x18 in., which, after being blue-printed, are indexed and bound in book form. Detail drawings of manholes, flush-tanks and of any other special form of construction required should be drawn to a convenient scale and all dimensions clearly shown in figures.

Specifications

Specifications should be prepared so as to specify in a clear, definite wording just what is included in the specifications and contract, and each part should be definitely and clearly specified so that there can be no question as to the kind of material or workmanship required in any part of the work. All materials should be required to pass a certain test as specified, and as far as possible based upon standard methods and tests made by the American Society for Testing Materials, or some other recognized authority on tests for the materials specified, but this should be clearly stated in the specifications so that there can be no doubt as to the method of making these tests, also the strength, etc., required for acceptance. This should include sewer pipe as well as other materials. It must be remembered that unforeseen conditions may arise and the specifications should be prepared with this in mind, so that the contractor, when he prepares his bid, may know clearly and definitely how he is to be paid for all classes of work that he may be called upon to carry out in the full execution of his contract.

The Irresponsible Low Bidder

In connection with the construction I think a brief reference to the prices bid or to be paid for the work is not out of place. Contractors sometimes, through lack of knowledge, by mistake or with a feeling that they will construct the work "good enough" or "just as good," but by methods and materials much cheaper than those specified, underbid the engineer's estimate and also underbid experienced, reliable contractors, who carefully prepare their bids with as small a margin of profit as is consistent with good work.

When these low bids come before a city council or committee the lowest bid is often accepted, sometimes with the advice of the engineer, but often contrary to the advice of the engineer, with the result that the contractor becomes insolvent, the city becomes involved in an expensive lawsuit, with a final result that the total cost to the city is considerably more than the amount given in other bids that would have given the contractor a fair profit and the city good value for the money expended and the kind of work specified.

The contractor should receive a price that will return a fair profit after completing the work in entire conformity with the terms of the contract, plans and specifications and the city should not accept a bid that is clearly shown by their engineer and also by a careful analysis of all the bids submitted, the costs of labor and material being carefully considered, that the price bid is too low to return a fair profit. Every possible consideration, however, should be given to the low bidders, and when the lowest bid is not accepted a clear, definite statement should be made giving the reasons in detail why it was not accepted.

Inspection

Careful inspection should be made of all materials as they are received, and where doubt exists as to the quality of the material, it should be tested before any part of the material is used. Some materials may be tested at the factories, but sewer pipe should not receive a final test until it is unloaded from the freight cars at its point of destination, and again inspected as it is being laid. Infiltration of ground water adds to the cost of the sewers due to the increase in size, and where the sewage is pumped before it can be treated at the disposal plant there is a continuous expense of pumping and also the additional cost for larger pumps and equipment. There is also an additional expense connected with the construction and maintenance of the disposal plant due to the additional amount of water, therefore the materials used as well as the workmanship in making these joints should be carefully inspected, as it is a very important part of the work. By far a greater part of the ground water in sewers does not filter in through good Portland cement joints, but comes in through holes in the joints that could have been avoided without additional expense if the proper care had been exercised in making the joints.

Laying Pipe

In laying sewer pipe, particularly the large sizes, it is very important that the bottom of the trench be properly prepared to receive the pipe and that the back filling under and around the sides of the trench be properly and carefully carried out. If the bottom of the trench should be in fine running sand, or soft material that will not make a proper foundation, a foundation of lumber, gravel or concrete must be used. If the bottom of the trench should be in ledge, shale or hardpan it should be removed for a depth of 6 in. below the bottom of the pipe and refilled with sand, fine gravel or earth that will thoroughly compact, and after this material has been placed and thoroughly compacted it should be shaped the same as the bottom of earth trenches. In excavating the bottom of earth trenches for all sewers more than 15 in. in diameter, the part below the grade one-fifth of the diameter of the pipe above the grade line of the sewer, the excavation should be shaped to fit the outside diameter of the pipe by using a form with a steel edge or shoe shaped on an arc of a circle with a diameter a little less than the outside diameter of the pipe. This is used in finishing the bottom of the trench just ahead of the pipe-laying. By excavating the bottom of the trench to fit this form and to the exact grade, considerable time is saved because it is lowered into place. It also has the additional advantage that the pipe is firmly and evently bedded, and as the diameter of the arc of the form used is less than the outside of the pipe, the bearing on the top part of the concave surface will be very firm, making practically an unyielding cradle for the lower part of the pipe.

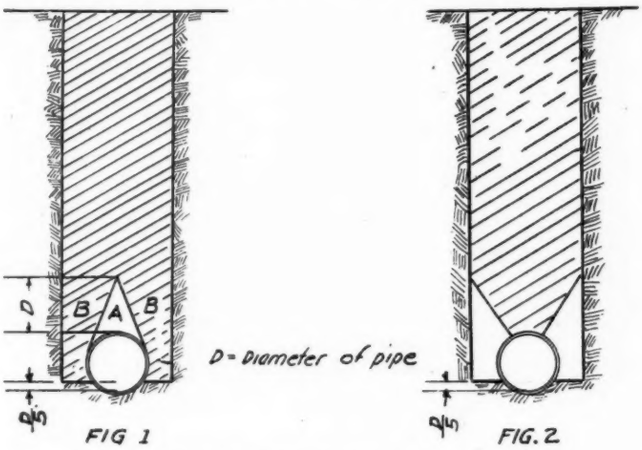
Bell holes should not be larger than is necessary and should be carefully back-filled and thoroughly tamped with special

tools for this purpose. It must not be overlooked that it is often necessary to use a concrete foundation and a concrete cradle to protect large size vitrified sewer pipe in trenches where the loads on the pipe would cause failure without this protection. Tests carried out and the results given by the Engineering Experiment Station, Iowa State College, and the American Society for Testing Materials are of great value to the engineer engaged in this kind of work, and these recommendations should be followed with the preparation of specifications, tests and laying vitrified sewer pipe.

Back-Filling and Tamping

The writer, however, has used the following method in back-filling and tamping around vitrified pipe sewers varying in size up to and including sewer pipe 36 in. in diameter. Materials that will thoroughly compact are selected for back-filling under and along the sides of the pipe, carefully placed and as thoroughly compacted as possible by hand-tamping.

As the back-filling reaches the grade of the center line of the pipe the tamping gradually approaches the center line from both sides, meeting at a distance above the pipe equal to the diameter of the pipe, as shown in Fig. 1. The area A above the pipe, while compacted from the tamping above, is not as firm as area B and I am of the opinion that as the load increases, due to the balance of the back-filling, there is an arching effect over the pipe, bringing a resultant pressure on



PRESSURE AREAS ON BACK-FILLED SEWERS.

the back-filling along the sides of the pipe and thereby relieving the pipe from a certain amount, but probably only a small amount, of the pressure that would otherwise rest on the center of the pipe if there was no settlement below a horizontal plane along the top of the pipe.

It also has its greatest favorable effect due to the fact that if these areas shown by B in Fig. 1 are not thoroughly compacted the earth begins to settle as the back-filling is completed and an arching effect takes place between the walls of the trench and the center of the pipe, bringing a resultant pressure on the center line of the pipe, as shown by the shaded section in Fig. 2, which is a much greater pressure along the center line of the pipe due to the settling in area B than would exist along this center line if there was no settling below a horizontal plane on the same grade as the top of the pipe. Once these conditions are thoroughly established around the pipe they will not materially change. Proof of this can be clearly shown in digging up old pipes that have been in the ground for years, where you will often find an unfilled space along the side of the pipe. The same is true at the sides of foundations and other underground structures.

The writer has found large size sewer pipe to fail under a back fill of 8 ft. above the top of the pipe where the back-filling along the sides of the pipe was not thoroughly tamped, while under his direction 30, 33 and 36-in. vitrified pipe sewers have been laid under back-filling as great as 30 ft. above the top of the pipe, and in 15 months after they were laid, through a very careful inspection found to be without cracks or any sign of failure. Thirty-inch sewer pipe that have failed have been replaced with vitrified pipe and the back-filling thoroughly tamped as above and in several months showed no sign of failure. I therefore believe that by far the larger percentage of the failures in the larger size vitrified sewer pipes could have been prevented by carefully and thoroughly compacting the back-filling under and around the sides of the pipe in the manner here suggested.

Sewers: When to Build and How to Pay

By Louis L. Tribus, of Tribus & Massa, Consulting Engineers, 86 Warren St., New York, N. Y.

When Cain was driven away from his boyhood home, because he failed in responsibility as his brother's keeper, it is a fair assumption that in the cities which he visited as a forlorn wanderer, few sewer systems were in existence. Some generations later, however, if excavated ruins tell the truth, the rich provided their extensive palaces and also some public buildings and market places with sewers; possibly for storm waters chiefly, but presumably as well for some human and household wastes; witness Rome and Crete.

Three Essential Phases of Sewerage Question

The sewerage question possesses three essential phases: (1) need; (2) suitable design and construction of sewers; and (3) paying the bills.

Need

As to the first; type of occupation, topography and soil all have bearing, but in general, it may be considered, when a community reaches the distinguished position of the possession of public water works, sewers must follow at once; else trouble develops.

Though dry disposal of excrement is practiced at times, notably at some of our army camps, water carriage is well-nigh universal because of its convenience. Scattered houses in country districts or even some favored villages, may be able to continue to use percolating cesspools, but usually the soil will not stand the strain long after modern plumbing is generally installed, for it becomes surcharged with liquid.

The unpleasant process of emptying cesspools becomes necessary, with an expense that soon cries for abatement so that sewers are demanded. Large estates may continue to operate individual disposal plants, but they do not as a rule seriously affect the average community's general needs.

Pressure From Board of Health

The first pressure usually comes from the Board of Health, which, for sanitary and somewhat from esthetic reasons, objects to overflowing cesspools, to polluted brooklets and to stagnant pools. Rightly so, for disease readily develops and spreads, not only lowering standards of health and perchance resulting in deaths, but also in other economic losses of time, wages and schooling; far more important features than most taxpayers realize. The influence of bad smells, also, may start a town thinking of sanitary precautions.

Granted that at times, portions of a village can get along with cesspools or other purely local disposal methods, while other districts can have no such facilities, the doctrine of mutual benefit comes straight to the front, and it must be said that very fair yielding to it is the general rule.

The earlier sewer problems are usually confined to meeting the "sanitary" needs, as the removal of domestic sewage is classed, but as desire grows for greater convenience, or perhaps it might better be said, less inconvenience, diverting storm flow also to underground channels becomes recog-

nized as a good policy. Here the benefit is obviously general rather than local, so that greater justice in taxing costs can be achieved, and spreading it over the drainage districts becomes the prevailing practice.

Much of interest could be said as to handling sewage in some Oriental lands, but special conditions there may not make the road center open channels so bad after all, for sun and scavenger dogs aid the bacteria effectively, though the sense of smell may be offended in the meantime. Smell is often thought to be unhealthful, but rarely does an odor cause harm; it is rather the red flag of danger.

The first object of sewers is to conserve health, the second, convenience, with, one might say, health affiliations.

Who are the beneficiaries? First, properties which can connect at once; second, those which ultimately may be reached by laterals, but do not need service at the time, and third, the incoming day workers from out of town, who find more healthful conditions attending their labor, and through rents pay their share.

Who Shall Pay?

Mutual responsibility having been recognized, need being apparent, sewers are ordered to be built. Who will pay? That becomes the big question, for one can fairly assume that the second factor, "design and construction" can be handled in a satisfactory manner, or at least with some regard to propriety and good engineering.

In a number of the states of this country the Department of Health controls the installation of sewers, i. e., as far as requirement and design goes, and quite properly demands the design of systems that shall provide for whole corporate areas, even though sewers may seem to be needed for only a part; and further, unless exceptional conditions prevail, suggestive plans for ultimate complete treatment works. No requirement for building the whole is enforced, but the plan must be comprehensive and parts first built be harmonious with the whole.

Treatment Works and Outfall Sewers of General Benefit

It is almost obvious that treatment works should be classed as a benefit to the whole community. If the works are large enough at first to care for the ultimate complete sewer system, the expense should be spread over the whole corporate area; if only sufficient for a portion of the sewer system, over its tributary area.

What applies to treatment works has equal force in regard to the larger outfall lines, which must be built large enough to care for the whole system when completed and in operation, if ultimate economy be considered.

Methods of Financing

Whether these design and construction costs should be covered by long or short term bond issues with sinking fund accompaniment, or by 5 or 10 or more serial payments, charged directly to the properties benefited, or by single direct assessments, depends very largely upon the sum of money involved and the financial abilities of the taxpayers.

As a matter of the greatest net economy, considering the financial interests of a full generation, the single payment system is the cheapest and the long run bond issue the most costly; yet there is some measure of apparent justice in spreading a cost that represents continued value, over a term of years, so that presumably a greater number of taxpayers will meet it, and the lesser annual payments be easier to meet.

It is almost universal custom to include maintenance and small repair costs in the annual tax budget and not an unfair policy at that, even if all properties have to pay a share; while some get no direct use of the sewers; for any sewers in service assuredly benefit to some degree the whole town. The principle of mutual responsibility and advantage is thus tacitly recognized.

Paying for Collecting Sewers

How to pay the bills for the collecting sewers themselves, outside of the costs of main trunks and disposal plant, heretofore discussed, brings, however, many a tough proposition to decide, and complaint universal.

The law guiding assessors, usually calls for a use of their judgment in assessing shares of costs according to the amount or benefit thought to be secured by each property. This necessarily takes into consideration the current use of properties. If carried out logically, three adjoining plots of equal land value, one unimproved worth $3,000, one, a $20,000 private residence occupied by a single family and the third improved with a $20,000 hotel for 100 guests, would pay very different proportions of sewer assessment, because of their varying use.

Payment for Actual Rather Than Possible Use.

Consider the possibility of a fire destroying the two buildings, shortly after the sewer assessments had been paid. Their owners decide to change from the previous use of the land; on the vacant lot is built a hotel with large need for sewerage, and on the hotel site rises a store with minimum plumbing equipment. The vacant lot owner paid but a small assessment, yet shortly makes the greatest use of the sewer, while the original hotel man paid the largest amount, yet secures but a slight final service. The underlying principle is fairly correct however, payment for actual, not simply possible use, for the differences indicated in the cases cited become fairly well adjusted in other ways and such violent changes as the one cited do not often occur.

Where rigid observance obtains, of the principle of actual use, assessors are very apt to throw upon the community at large, a proportion of cost representing the sewers within lines of street intersections, and also some of the expense, where corner lots have sewers at both fronts and sides.

Various Ways of Paying

Not infrequently the total cost is divided into bond issue for one-half the cost for say 30 years, and direct assessment on properties benefited for the balance in proportions as may seem equitable and not burdensome.

In the old City of New York (now Borough of Manhattan) sewers were chiefly of the combined type and rarely less than 12 ins. in diameter; the custom became well fixed, of assessing directly on frontage the estimated equivalent cost of 12-in. sewer and over the tributary watershed the excess expense where larger sizes were placed. The relation of the assessments to large property values, rendered this a fairly just measure, but in the more recent development of the outlying boroughs where much lower land values prevail, great temporary hardship often has ensued, though partially relieved by legislation permitting ten annual prorata payments with interest on deferred sums, when the total exceeds certain amounts.

Under New York Village laws, many sewers were at one time built, through annual district taxation, each year certain lines being constructed. This resulted in a gradual completion of systems, on a basis of practically annual payments; a good method when honestly carried out and recognizing again, community responsibility and benefit.

Ideal Financing

As a financial problem solely, the nearer one payment for each property meets the cost of sewer construction, the cheaper in the long run and the more nearly are the best interests of all concerned.

No one set of rules can be promulgated that will be just under all conditions; a place where the large majority of property owners are day-wage earners, may have to resort to long time scattered payments, because of the imprac-

ticability of keeping savings long enough to meet large single payments.

In a large city with high cost properties occupied by those of wealth or with accumulated capital, the single payment becomes suitable. But in all cases, sewers are needed but none likes to pay for them.

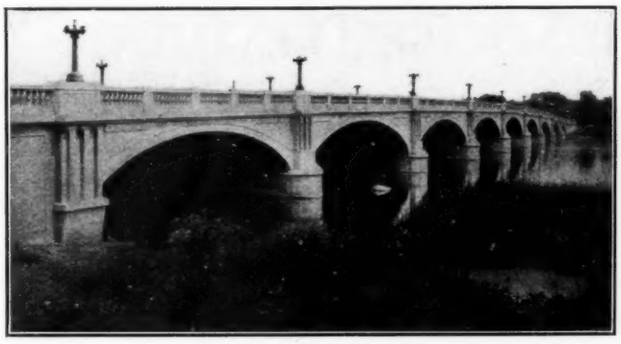
BRIDGES AND BUILDINGS

The Franklin Street Reinforced Concrete Bridge, Waterloo, Iowa

By E. K. Borchard, Engineer, 30 Broad St., New York.

There may be some isolated locations for bridges where beauty should be subordinated to utility, but these are few and never within any municipality or township. In concrete bridges, good appearance may be secured without any sacrifice of utility or low first cost; and this factor makes concrete the first choice for municipal bridges.

Previous to the last two decades there had been little attention devoted to designing and building a bridge that was in harmony with its surroundings and pleasing to the eye. Open trusses and plate girders were provided with no effort at ornamentation or good appearance.



VIEW OF THE FRANKLIN STREET REINFORCED CONCRETE BRIDGE, WATERLOO, IA.

Today in concrete bridges even of the very smallest size, some simple ornamentation is provided at practically no increase of cost—in addition to the naturally pleasing look of sturdiness and solidity inherent in concrete construction.

Concrete Arch Bridges

The arch has admittedly a more substantial look than any other type of bridge superstructure. The large mass of the concrete in an arch absorbs all vibrations from vehicular loads —at the same time the arch provides ample waterway or headroom.

The bridge shown in the illustration shows admirably the possibilities of concrete bridges for highways. This bridge is the Franklin Street Bridge at Waterloo, Iowa. The ornamentation is simple and dignified—yet only possible in concrete without excessive cost. This bridge shows only a moderate effort toward ornamentation; many bridges have been built of concrete in very ornate style.

Design Features

In the bridge shown the surface of spandrel walls are relieved by a sunk panel, while the arch ring is accentuated by a V-groove. At piers and abutments a very pleasing yet simple treatment is given by breaking what would otherwise be a broad expanse of concrete into ribs to give the effect of three narrow columns.

The balustrade guard rail deserves special notice for the neat balusters of concrete, surmounted by a concrete guard rail. Consider what the cost would be if these balusters and rails were all worked in stone. The guard rail pedestals over every pier and abutment support metal lighting standards, each provided with five electric light globes.

Advantages of Concrete

Good appearance is only one of the advantages of such a bridge as this. Low first cost, absence of maintenance costs, resistance to floods and permanence are additional reasons for building of concrete. With this bridge there will be no need for periodic renewal of bridge floor with consequent obstruction to traffic and no heavy expenses for repainting every few years.

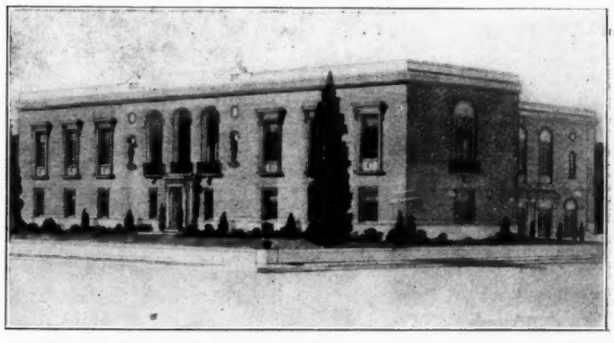
New Club Building of The Engineers Club of Dayton

The new club building of The Engineers Club of Dayton, Ohio, is to be dedicated February 2, 1918. The structure, in perspective, is here illustrated. The membership of the club at this time is about 300.

The Building

The building is located at the southeast corner of Monument avenue and Jefferson street, facing the river, near the center of the city. The classical detail has been followed in the architectural design of the building, giving a refined dignity consistent with the high class character of the entire structure. It is three stories high, facing 150 ft. on Monument avenue and 125 ft. on Jefferson street.

The exterior is built of Bedford, Indiana, limestone and soft-toned gray buff brick laid in Flemish pattern with wide



PERSPECTIVE VIEW OF NEW CLUB HOUSE, ENGINEERS CLUB OF DAYTON.

white mortar joints. The design is a strong Georgian effect giving a dignity and refinement well adapted for an engineering building.

The main entrance fronts on Monument avenue although there is also an entrance on Jefferson street as well as porte cochere entrance on the east side. Passing through the main entrance one enters a simple vestibule which opens into a very attractive first floor lobby.

Directly south of the lobby entrance is a broad English stair leading to the second floor, treated in Caen stone effects,

with ornamented ceiling and frieze. To the right of entering are located the secretary's office and telephone booths, and beyond is a large billiard and game room which is provided with a large stone fireplace, English ceiling and wainscoting and cork floor.

To the left of the lobby is a broad visiting gallery at the east end of which is the porte cochere entrance. Entrances from the gallery also open to the sunken garden to the south and the ladies' reception room carried out in the Adam period of refined detail. A ladies' retiring or dressing room adjoins the reception room while check and toilet rooms are conveniently located.

South of the lobby and down marble steps is the dining room foyer with checking facilities and entrance to the sunken garden to the east and Jefferson street to the west.

Directly south of this foyer is the main dining room off which open eight private dining rooms, all of which may be thrown together with the main room making a large room for banquet purposes. South of the dining room is a white serving room and kitchen provided with the latest improved equipment for efficiently handling the service of the Club.

From the second floor lobby open a large loggia to the north, large lounging room to the west, library and conference rooms to the east and an auditorium foyer to the south.

The lounging room, located directly over the billiard room is 30 by 50 ft. with a large stone fire-place on the south side, high English wainscoting and heavy wood beamed ceilings, all kept in soft quiet coloring making a restful atmosphere.

Just east of the lobby is located a large library and reading room, off which open two library alcoves and two large conference rooms, in all of which bookcases are built to the ceiling accommodating over 10,000 volumes.

From the auditorium foyer one enters a large, spacious auditorium or lecture hall, accommodating about 450 persons, which is provided with a sloping floor, easy fixed seats, large stage and a thoroughly equipped fireproof lantern booth. This booth is entirely concealed at the rear of the auditorium and is provided with all modern appliances and conveniences. Four fireproof stairways lead from the auditorium to the ground level which, together with a fireproof building, offer the best possible protection to the occupants.

On the third floor are two bed rooms. A suburban locker room is also provided on this floor for the convenience of those members living some distance from the Club building. The whole building is provided with large steel casement windows affording ample light.

WATER PURIFICATION AND SEWAGE TREATMENT

The Electro-Chemical Sewage Treating Process as Operated at Decatur, Ill., in 1916

By W. S. Shields, Consulting Engineer, Hartford Bldg., Chicago, Ill.

For the past ten years the city of Decatur, Ill., has been confronted with the problem of securing an adequate means of sewage disposal. It is a manufacturing city with a present population of some 50,000 people, and is located on the Sangamon river, a stream having a watershed above Decatur of some 862 square miles and a recorded flow varying from 0 to 4,500 cu. ft. per second. The city gets its water supply, which is now inadequate during dry seasons, from this river, by means of a dam which impounds sufficient water to draw from during seasons in which the flow is insufficient. For this reason the river below the dam has no flow for long periods of time in dry seasons except that produced by the sewage from the city sewers.

Sewage Collection System

The sewer system is on the combined plan, with four main outlets into the river below the dam. These sewers are known as follows:

(a) The Broadway sewer, a brick sewer of 84 in. diameter, serving a district of some 1,370 acres, including the major portion of the business section, the gas works, the Wabash Railroad shops, the Staley Starch Works and a slaughtering and packing establishment. It carries an unusually strong sewage, including approximately 1,000,000 gal. of waste liquor from the Staley starch factory, which contains sulphurous acid and is heated to such a degree as to create offensive odors when mixed with city sewage, causing numerous complaints from residents along the line of the main sewer. This sewer enters the river just below the dam at an elevation of 581 ft. above sea level.

(b) The Union street sewer, 60 in. in diameter, serving a district of some 434 acres, with some business property and factories, but mostly residences. It has a daily dry weather flow of some 1,500,000 gal. of average city sewage. It enters the river near the Broadway outlet and at an elevation of 591 ft.

(c) The Oakland street sewer, 36 in. in diameter, serving a district of some 155 acres area, all of which is residence property. The flow of this sewer is some 10,000,000 gal. per day. It enters the river valley at an elevation of 610 ft., then drops to the river bottom and enters the river at an elevation of 584.09.

(d) The Seventh ward sewer, a 7-ft. sewer, serving a district of some 530 acres of urban property, parks and some unsubdivided property. Its dry weather flow has been given at 1,000,000 gal. per day and its outlet into the river is at an elevation of 583.90 ft.

The elevation of the crest of the dam is 593 ft., and the water below, at ordinary stages, is 588.3 ft., with a fall of some 2 ft. per mile down stream. The valley is some ¾ mile wide, with high banks or bluffs on each side; the bottom lands have an elevation of some 596 ft., with a flood height of 605 ft.

Imhoff Tanks and Sprinkling Filters Recommended in 1915

In 1915 Messrs. Langdon Pearse and Samuel A. Greely, consulting engineers of Chicago, after making experiments with Imhoff tanks and sprinkling filters, reported upon several schemes for collecting and treating the city sewage, and recommended a scheme involving an intercepting sewer, partly in tunnel, and a treating plant consisting of Imhoff tanks and sprinkling filters, located near the outlet of the Seventh ward sewer. The cost of the improvement recommended was estimated then at:

For 15 acres of land, right-of-way, etc.	$ 4,500
For intercepting sewer and connection	244,335
For treating plant and accessories	484,840
Total for improvement	$733,675

Their estimated annual operating expenses, including depreciation and interest, was $43,722, or $20 per 1,000,000 gal. for a 6,000,000-gal. daily flow.

Their scheme did not include the treating of the starch waste, the plant not being in operation during the period when the experiments were made, but they recommended that this waste be treated separately by the company, should the plant again operate.

On account of the high cost, its inability to issue sufficient bonds, and the remaining problem of the starch waste, which again appeared, the city was loth to undertake the improvement recommended.

Electrolytic Lime Process Tried

In May, 1916, the Electrolytic Sanitation Company, of Chicago, became interested in the problem and made examinations of the starch waste, taken as it left the factory, and of the sewage containing this waste, at the outlet of the Broadway sewer, also of the city sewage proper without the starch waste, and being desirous of demonstrating to the city and public the ability of the electrolytic lime process successfully to treat sewage, requested of, and were granted by, the city officials the privilege to erect and operate a treating plant of 1,000,000 gal. daily capacity.

The Electrolytic Process

The electrolytic process, as many of the readers will understand, consists in adding sufficient lime to sewage or polluted water to neutralize the acids therein contained and leave a slight excess of lime, then to subject the sewage to an electrical current of low voltage by causing it to pass between iron plate electrodes, arranged in banks; the current, acting electro-chemically upon the sewage, electrolyzes it, forming nascent oxygen and hydrogen. The time of contact is but a few minutes, yet as it leaves the machine the suspended and colloidal matters are floculated and quickly separated, leaving a bright and generally stable effluent. The amount of lime used varies with the acidity and other chemical conditions of the sewage.

A test of the starch works liquor indicated that 4.5 tons of lime per 1,000,000 gal. would be required to neutralize the acids therein, while the sewage at the mouth of the sewer, containing one part of this same waste and two parts sewage, required but 1.5 tons per 1,000,000 gal.

Agreement Between City and Company.

The essential conditions in the agreement made between the company and the city, prior to the erection of the plant, were that the company should install a test plant of 1,000,000 gal. daily capacity; that a continuous test of 45 days' run should be made, which should be considered an official test; that during this test the machines should be operated under the direction of the engineers of the company and that the tests should be made and the results determined by two chemists, one selected by the city and the other by the company, and their reports and analysis, if they agreed, should be considered as official, and if they did not agree, then a third chemist should be selected to determine the results, and that his report should be accepted by both parties.

Guarantees Made

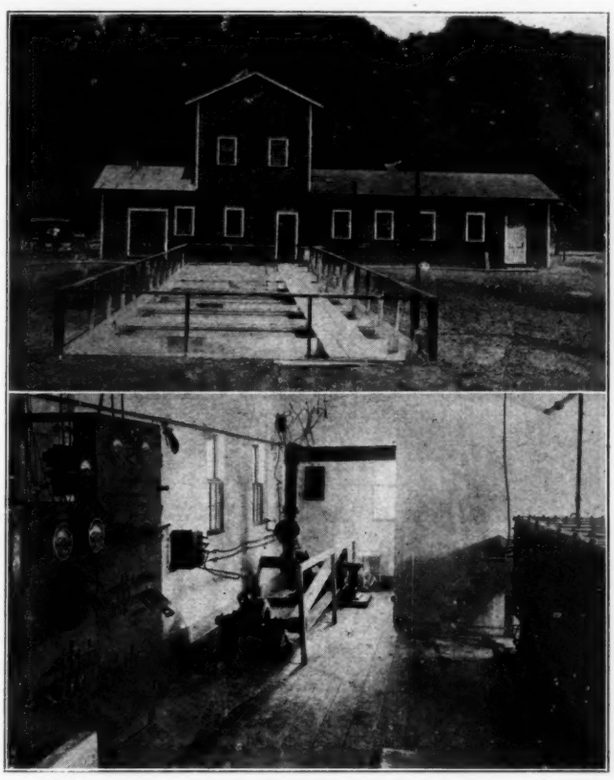
The company made the following guarantees:

(a) That the final effluent from the sewage passed through our plant and after one hour's sedimentation will show a removal of not less than ninety per cent. (90%) of suspended matter and ninety-five per cent. (95%) of bacteria, and will not be offensive in odor or detrimental or injurious to animal or fish life, and shall be subject to any reasonable or enforceable objection on the part of the Rivers and Lakes Commission of the State of Illinois.

(b) That the sludge will be pressed and removed without creating a nuisance or disseminating offensive odors.

(c) That not more than one ton of lime (calcium oxide) and 200 kilowatt hours of electricity will be required for each million (1,000,000) gallons of city sewage treated.

(d) That the plant, when operated in accordance with our instructions, will cause no offensive odors or be a nuisance in any way. If the above guarantees or any of them are not fully complied with to your satisfaction,



VIEWS OF ELECTRO-CHEMICAL EXPERIMENTAL SEWAGE TREATMENT PLANT AT DECATUR, ILL.

Exterior View of Plant. Apparatus Housed. Settling Tank in Foreground—Intervior View of Plant Showing Switchboard and Electrical Treating Machine.

we agree to remove the plant, without expense to the city of Decatur of any kind whatsoever, except those expenses specifically mentioned herein for the city to furnish free.

In return the city commissioners, not being in position legally to enter into a contract, agree that should the plant conform to the aforesaid guarantees and requirements, and each of them, then the Board of Commissioners agrees to do everything in its power to carry out the plans hereinafter mentioned. In the consideration of the proposal before the City Commission it was explained and understood that the term "city sewage" was to be understood as sewage without starch waste.

Design of Plant

For convenience of location and operation it was later decided to locate the plant to take the sewage from the Broadway sewer and a site was furnished which required the pumping of the sewage to be treated.

The plant consisted of a low frame building 18 ft. wide by 72 ft. long, with a room for lime mixing and feed tank over the central portion thereof. The sewage was drawn from the bottom of the main sewer into a pit, from which it was lifted by a 6-in. motor-driven centrifugal pump into an elevated feed tank, in which was placed a measuring weir and overflow pipe to control the amount to be treated. The presence of the starch waste in the sewage produced such an offensive and

sickening odor that special care had to be taken to provide air-tight partitions around this tank.

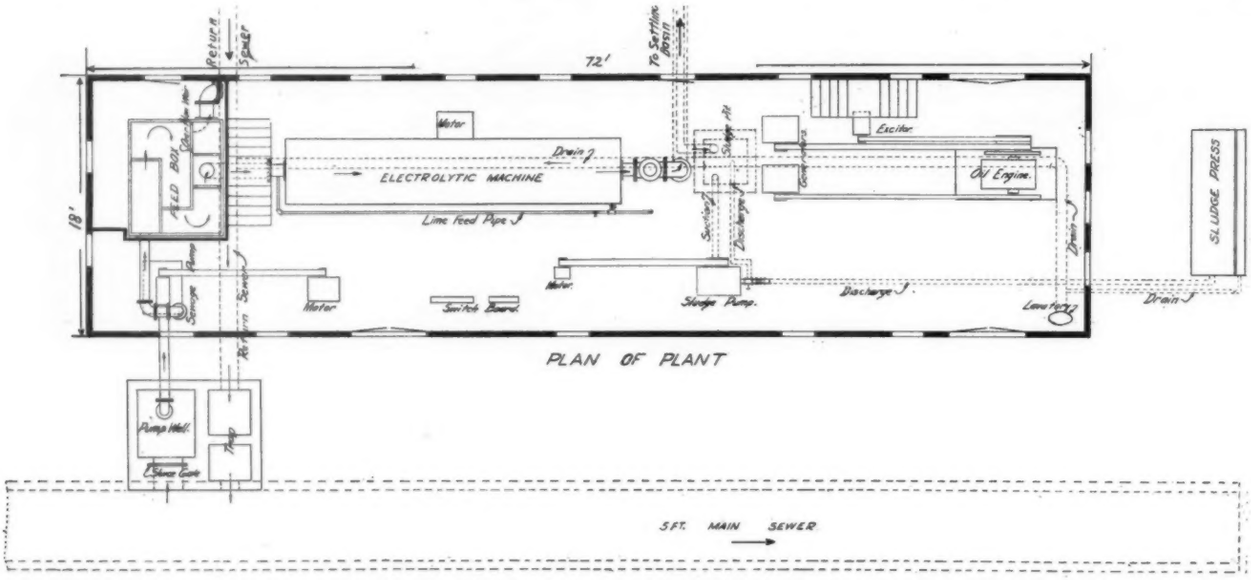
Screen Troubles

The Broadway sewer had a swift current and carried along its bottom an unusually large amount of grit and heavy matter, consisting of cinder from the railroad shops, coke washings from the gas works and flesh and hair from the slaughter house, and, owing to the method of connecting, practically all of this heavier matter flowing in the bottom current was drawn on to the screen, consequently the screen arrangement, while ordinarily sufficient for city sewage, was overtaxed and required much care and attention to keep it clear. The odors caused by the starch waste made this screening offensive to work with, and the screen caused more delays and stoppage of the machinery than all other sources combined.

The Treating Machine

The treating machine is a wooden box or closed flume, 23½ ft. long, with nearly square cross-section, 3 ft. on each side. It was mounted on a concrete base, was water-tight, with vents for releasing gases, and was provided with 10-in. circular openings in the center of the ends for the entrance and exit of the sewage.

The machine contains 22 banks of electrodes in two series of 11 each, consisting of 48 iron plates 3/16 in. thick and 10x



PLAN OF PLANT

PLAN OF ELECTRO-CHEMICAL EXPERIMENTAL SEWAGE TREATMENT PLANT AT DECATUR, ILL., SHOWING ARRANGEMENT OF MACHINERY.

16 in. The plates are ⅜ in. apart and between each plate there are two revolving paddles, driven by a 3-h.p. motor, to agitate and mix the sewage and to keep the surface of the plates clear of sludge and debris; in fact, the machine may be described as a huge electrolytic cell, and every part of the sewage passes between and is subject to the electrolytic action of a current of 40 volts and 70 amperes.

Settling Tank

From the machine the treated sewage passed to an open settling tank outside the building. This tank was constructed in excavation and lined with plank sheeting. It had dimensions 18 ft. wide by 60 ft. long by 10 ft. deep below flow line. The sewage entered the tank by falling over the side of a wooden trough extended across the inlet end, and in one end of this trough was an adjustable outlet weir to control the quantity of treated sewage to be passed through the tank. Baffle boards were provided and an outlet trough on the outlet end discharged through a weir chamber into a sewer which could carry the flow either back into the main sewer or into an open ditch, through which it could flow for several hundred feet and then enter the main sewer through a surface water opening.

Change from Flat to Hopper Bottoms

In adjusting and testing the plant prior to beginning the test it developed that, owing to the nature of the starch waste, the sludge which settled in the tank became septic rapidly and the flat-bottomed tank had to be changed to hopper bottoms, with a sludge pump and suction pipe, with a branch into the bottom of each hopper. The installation included a small sludge press of the Johnson type and a sludge pump and generator for producing current to operate the treating apparatus, and also a small oil engine. The latter was used more as an emergency machine than as a necessary part of the plant.

The Lime and Lime Equipment

The lime used was unslaked, lump lime, purchased on the local market and hauled a distance of approximately one mile, then elevated to the second story by hand, which made the operation both expensive and wasteful. The lime equipment consisted of a slaking tank and two solution tanks, in which were placed agitating apparatus driven by a motor. The lime mixture was pumped from the tank by a centrifugal pump to an elevated box, having an overflow so arranged that the excess mixture might return to the feed tank. The feed pipe extended from the box to connections at both ends of the treating machine, with valves so arranged that lime could be added at either end.

The inclusion of the starch waste not contemplated by the manufacturer when the equipment was shipped resulted in this lime-feeding equipment being inadequate for best operation, and as the electrolyzing of the free lime is an important function of the treatment, interruptions in line feeding necessarily affect the results and induce conditions which would not normally be present in a treating plant.

The Official Test

Construction work was started in the latter part of May and the plant put into operation early in July. As this was the first plant or complete installation on sewage work, and as the plant was to be temporary, there was, as in all first experimental plants, a number of changes and adjustments to be made, so that the official test was not started until the 31st day of July.

To conduct the official test the city selected as its chemist

TABLE I—CHEMICAL RESULTS OF ELECTRO-CHEMICAL SEWAGE TREATMENT AT DECATUR, ILL.

	Starch Waste Liquor (Raw)	Raw Sewage Union St. Sewer 2 Samples	Raw Sewage Broadway Sewer Without Starch Waste	No. 3 After Treatment	Percentage of Reduction	Raw Sewage from Broadway Sewer including Starch Waste Av. 28 Samples (Composite Daily)	No. 5 Treated and with ½ Hour Sedimentation	Percentage of Reduction	No. 5 Treated and with 1 Hour Sedimentation	Percentage of Reduction
	1	2	3	4		5	6		7	
Total Solids	5866	1049	1184	839	....	1917	1585	....	1462	....
Soluble Solids	2133	703	964	803	....	1460	1494	....	1412	....
Suspended Solids	2733	346	220	36	83.6	457	91	80	45	90
Nitrogen as Free Ammonia	1.0	14.90	11.60	10.90	.60	20.01	9.50	52.5	11.3	43.5
Nitrites	.02	.025	.02	.12	....	.04	.20	....	.23	....
Nitrates	None	.265	.23	1.01	....	.56	.96	....	.94	....
Total Organic	590	22	28.10	20.60	27.0	79.2	69.80	11.8	62.0	21.7
Oxygen Consumed	1925	160	196	154	21.4	436.0	348	20.0	375	11.7
Lime (CaO) Required	1064	180	227	....	....	320.0	....	....	....	....
Lime pounds p. m. g.	8954	1504	1891	....	....	2671	....	....	....	....
Calcium Carbonate from Lime added	....	....	....	29	....	....	41	....	23	....
After deducting the calcium carbonate added by the treatment	....	....	....	....	96.8	....	....	89.0	....	95.2
Av. Current used k.w.h. per million gallons as treatment D. C. 40.5 volts 66.75 amperes							75.28			
For turning paddles							44.42			

Dr. O. F. Reynolds, of St. Louis, Mo., and Prof. A. A. Tyler, of the Milliken University, at Decatur, as bacteriologist, while the company was represented by Messrs. Mariner & Hoskins, of Chicago, through Dr. J. Warne Philips in charge. These gentlemen each submitted separate reports which agreed in all essential particulars.

The test ran through 28 consecutive days and was terminated at the request of the city, as results were considered sufficiently demonstrative. The chemical results are indicated upon Table I, herewith shown. The quantity, conclusions, character and constituent parts of the resultant sludge was agreed to by both chemists and reported in Table II, herewith. They differ, however, as to the value of this dry sludge.

TABLE II—ANALYSIS OF SLUDGE FROM SEWAGE CONTAINING STARCH, WASTE LIQUOR, DECATUR, ILL.

Pressed Cakes.

Moisture 59.70
Solids 40.30

	Dry Samples (per cent.) Reynolds (1 sample)	Philips (4 samples)
Volatile Matter	52.76	51.67
Non-volatile Matter	47.24	48.33
Nitrogen	1.84	1.58
Calcium Oxide	18.20	13.63
Calcium Carbonate	33.93	33.93
Total Phosphoric Acid (P_2O_5)	4.40	4.50
Phosphoric Acid (Available)	3.60	3.78
Potash	.37	trace
Total Grease	5.94	7.37
Free Grease	1.51	1.14
Fatty Acid	4.43	6.16
Moisture	6.36	6.36
Tons per m. g.	4.5	4.77

Findings of Chemists

The chemists both agreed to the following:

(1) That the process when applied to the combined flow of all sewers, including the starch waste, will fulfill all conditions of the guarantees.

(2) That the effluent containing starch waste was not stable by the usual methylene blue test, but owing to the action of sulphurous acid, this test was not a fair one, as samples of the effluent when exposed to the air in open vessels did not become offensive, but improved in color and odor.

(3) That the effluent from treated city sewage without the starch waste would have a stability of 100.

(4) That existing odors were destroyed and none produced.

(5) That fresh sludge when pressed and piled in the open did not develop odors.

(6) That city sewage without the starch waste could be successfully treated with 1,500 lbs. of lime per 1,000,000 gal.

Summary of Dr. Tyler's Report

A summary of the report made by Dr. Tyler on his bacteriological tests showed the following:

Sixteen samples were examined and showed:

	Per cent.
Reduction on Agar	85.0-99
Average	95
Reduction on Gelatine	87.5-99.5
Average	95
Total Average Reduction	95
Gas Formers (4 samples) Reduction	99
Liquifiers Reduction, about	99
Stability of Effluent	99

He further reports that, bacterial action still goes on, but the gas formers and liquifiers are so well eliminated that the effluent would never become offensive, and also states in closing that "The process is especially efficient in the destruction of colon bacilli and other putrefying bacteria, thereby destroying the offensiveness of the sewage in a high degree."

A Five-Million-Gallon Plant

The data obtained by operating the experimental plant and the reports of the chemists, as to the requirements, indicated that a plant constructed to treat the combined gravity flow of the Broadway and Union Street sewers, including such other smaller areas which might be brought to it by gravity or low lifts, would require an installation, having a daily capacity of 5,000,000 gals., with provisions for extending to 7,000,000 gals. by the addition of two other machines. Such a plant was outlined and estimated to cost approximately $200,000, including land, rights-of-way and the necessary intersecting sewers to bring the sewage to the plant at such an elevation that pumping would not be required.

It further shows that the greater dilution by the addition of the flow from the Union Streeet sewer would reduce the lime requirements when the starch waste is included, to at least 1 ton per 1,000,000 gals.

Cost of Five-Million-Gallon Plant

The cost to operate a 5,000,000-gal. plant to treat sewage containing the starch waste might be taken as follows:

	Per Year	Per m.g.
Administration and Overhead Charges	$ 2,555.00	$ 1.40
Labor—Three engineers, three assistant engineers and three laborers	8,600.00	4.71
Lime—One ton per million gallons on 365×5=1,824 tons @ $5.90 per ton	10,767.50	5.90

Power—For screens, treating machines, sludge pumps, presses, driers, elevators and conveyors, lime crushers, and agitators, lighting and losses in transmission, 1,000 k.w.h. per day or 1,000×365 @ 1¼c per k.w.h.....	4,562.50	2.50
Sludge Drying—2.0 tons of coal per day, or 730 tons of coal, @ $2.40.....	1,752.00	.96
Heating—150 tons of coal, @ $2.40.....	360.00	.20
Oil waste and general supplies.....	1,283.00	.70
Maintenance, repairs, etc.	5,110.00	2.80
Total to operate	$35,000.00	$19.17
Interest and depreciation (7½%).....	15,000.00	8.23
Total	$50,000.00	$27.40

Value of Sludge

The Chemist reported that the sludge when dried to a 6.36% moisture had a specific gravity of .768 or 48 lbs. per cubic foot, practically one-third of which would be calcium carbonate, the value of which is doubtful. The present market price of nitrogen is unusually high and would warrant at least the following values per parts indicated, and assuming four tons of dry sludge per 1,000,000 gals. of sewage treated, the following values might be expected:

	Per m. g.	Per day
Nitrogen 1.71 units ×4=6.84 @ $3.00*.....	$20.52	$102.60
Phosphoric Acid units 3.69×4=14.76 @ 10c.....	1.48	7.40
Total	$22.00	$110.00
Cost to pump, press, and dry and prepare @ $2.50×4=	10.00	50.00
Available for Income	$12.00	$60.00

*Present market price $5.75 per unit.

Sludge Utilization

The utilization of this sludge in a manner to reduce the cost of operation is the part of the problem not solved, but in quantity it would amount to some 7,500 tons or 11,500 cu. yds. per year. If used as a fertilizer base the most economical solution would probably involve an equipment for manufacture of a fertilizer adapted for local requirements, rather than to sell wholesale where two freight rates must be charged against it before it reaches the consumer.

With no Current on, Polerization of Plates Aids Lime Treatment

Objections were made to the process that nothing had been accomplished which could not have been secured by a treatment of the sewage with lime alone and that the electrical treatment produced little or no effect; and to substantiate this claim the plant was operated by the city for several days when lime was added to the sewage and it was passed through the machine without the electrical current. Analyses made of samples taken during this time showed results much superior to anything that has heretofore been secured by lime treatment.

As the test was made without the knowledge of the company, the actual conditions, which then obtained, were not known to the writer, but undoubtedly the results were influenced by the electrodes, the plates of which were polarized to a degree as to produce a beneficial effect. The period of sedimentation used to obtain the results were not stated nor the rate and time in which the sewage was passed through the machine was not given. This is important, as the length of time in which the lime-treated sewage remained in the tank, more or less filled with sludge treated by electricity, would have beneficial effects.

An examination of the plates of the electrodes, after the few days' run without current, indicated a decomposition of the alternate plates, amounting to considerable more than had occurred during the entire period prior to that time; this indicated that a considerable quantity of iron had been decomposed which would have beneficial effect. At the end of this run the settling tank indicated septic conditions and more odor had developed than at any other time during the operation of the plant.

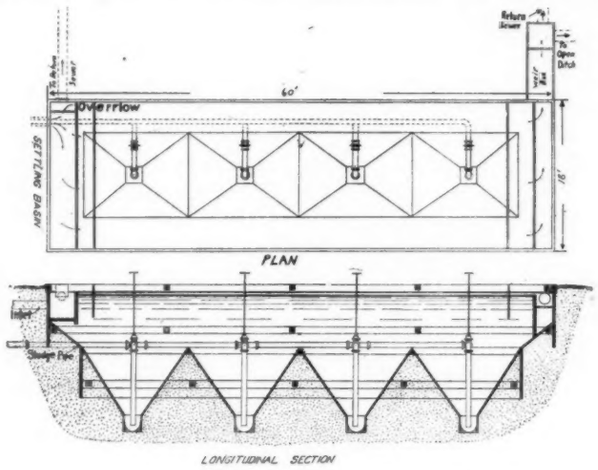
All Guarantees Fulfilled

The company were unjustly criitcised for refusing to allow this test to continue as their machines were not built for lime process nor could they be used in this way without serious detriment.

At a heavy expense the Company had demonstrated that the process would successfully treat a combined sewage and trade waste of such a nature that no other process had been able to treat and at a cost to construct and operate quite within reason. According to the reports of the chemists employed, and their standing and ability cannot be questioned, all of the terms of the guarantees had been fulfilled and they are justly entitled to high credit for what they had done.

Some Cost Comparisons

Mr. Harrison P. Eddy in his paper read before the Western Society of Engineers in Chicago in October, 1916, in which he makes a comparison of the Activated Sludge Process with that of Imhoff Tank-Sprinkling Filter, makes comparative estimates on hypothetical plants of 5,500,000-gal. capacity. His summary of cost to construct and operate is here shown, together with that of an Electrolytic-Lime Process plant of



PLAN AND LONGITUDINAL SECTION OF SETTLING TANK OF DECATUR EXPERIMENTAL SEWAGE TREATMENT PLANT.

equal capacity, but to compare with the excess reserve capacity given by Mr. Eddy for the other plants the cost to furnish and install two additional units of 1,000,000 gals. capacity has been added to the cost for construction. The cost of operating the electrolytic plant has been reduced to conform with the cost of treating the average city sewage by a reduction in the quantity of lime to 1,500 lbs. per 1,000,000 gals. and the cost for power to 1 ct. per k.w.h, corresponding with that used in the other two plants.

COMPARATIVE CONSTRUCTION AND OPERATION COSTS OF SPRINKLING, FILTERS, ACTIVATED SLUDGE AND ELECTROLYTIC LIME.

Cost to construct	Sprinkling Filters	Activated Sludge	Electrolytic Lime
5,500,000 gal. plant.....	$431,750.00	$314,050.00	$235,000.00
Per 1,000,000 gals.	78,500.00	57,100.00	47,000.00
Per capita	7.85	5.71	4.70
Cost to Operate.			
Operating expenses	$ 17,080.00	$ 40,140.00	$ 31,385.00
Interest and Depreciation....	26,760.00	19,780.00	17,625.00
Cost per annum	43,840.00	59,920.00	49,010.00
Cost per 1,000,000 gals.....	21.84	29.85	24.50
Cost per capita	.80	1.09	.88

With the Electrolytic-Lime Process there would be produced, in the cost given, some 2,000 tons of dry sludge which if disposed of, at cost to press and dry, would show a cost

per capita to operate equal to or below that of the Sprinkling Filter.

Advantages of Process

The process has great possibilities and many marked advantages over either the Activated Sludge or Settling Tank and Sprinkling Filters. It has, of course, its limitations and is not adapted for all conditions. Among its advantages are the following:

(1) It requires a minimum of land and building space, two acres being generally sufficient for five to ten million gallon plants. Owing to the elimination of odors the plants may be located nearer to the cities and thereby obviate expensive outlet sewers.

(2) It requires a minimum of fall to be operated by gravity, 3 ft. or even less being practicable.

(3) The equipment is simple and can be operated by any mechanical engineer without much attention from the chemist. The sewage is enclosed during treatment and the treating and equipment room may be maintained as neatly as a water filtration plant.

(4) The action is practically instantaneous and does not rely upon specially prepared cultures of bacteria, which must be maintained with the greatest of care, and if destroyed or neglected will require days to restore or reproduce. There is no putrefaction or septic conditions and with average sewage both effluent and sludge are stable.

(5) Existing odors are destroyed and with ordinary care none are produced. This was demonstrated at Decatur to a remarkable degree.

(6) Under favorable condition in small installations a night flow of sewage may be stored and the plant operated in day hours only.

(7) It is not seriously affected by climatic conditions or temperatures and owing to the restricted area is well adapted to cold climates.

(8) It makes possible the most economical handling of resultant sludge, which, owing to its stability, can be handled in many ways. The present cry for conservation of land products will devise ways for utilizing it to the advantage of the producers. The free lime in the effluent will act as a cleanser of streams into which it may be discharged.

If the process were not patented and had received half the skilled study and experimentation from sanitary engineers, which the Activated Sludge Process has been given, it would have an equal standing. As in all new processes, improvements will be made to simplify and improve apparatus and lower costs. Plates have been in use now for three years and the manufacturer believes that they should last for five years under average conditions. It has winning qualities and will successfully survive the present criticisms and receive proper recognition.

FROM WORKERS IN FIELD AND OFFICE

Pettis County, Missouri, Highway Bridges

Editor of MUNICIPAL ENGINEERING:

Sir—In the November issue of MUNICIPAL ENGINEERING you publish an article by Mr. T. O. Stanley, Highway Engineer of Pettis county, Sedalia, Mo., relative to bridges that have recently been built in that county. Two of these bridges are illustrated to a limited extent, and the cost price of each is given.

We are particularly interested in the "Elm Branch" bridge, a reinforced concrete slab or girder 30-ft. span with 18 ft. roadway, built at a cost of only $569, and would greatly appreciate further details of this structure, showing general dimensions, thickness of slab or depth of girders used, and size and spacing of reinforcing.

Mr. Stanley says: "In all our work we buy the material, hire a reliable foreman and erect the bridges by force account and eliminate the contractor's profits, as we think we can do it as well as he can, and at least save the overhead expense." While it is very laudable in Mr. Stanley to save his county the profits and overhead of the contractor, he could be of further and far greater benefit to the country at large by furnishing illustrations of his bridge designs, giving methods of erection including formwork, concrete mixtures, reinforcing, methods of calculation, and other items that influence cost price. The writer feels confident that you will give space in your valuable publication for Mr. Stanley to furnish detailed information, since this is directly in the interest of the taxpayers and engineers who are "looking for the light."

Very truly yours,

J. B. MARSH,
Consulting Engineer.

Des Moines, Iowa.

(The foregoing letter was referred to Mr. Stanley whose reply follows:—Editor.)

Editor of MUNICIPAL ENGINEERING:

Sir—The Elm Branch bridge was reinforced with one 12-in. channel on each side and with six 12-in. I-beams between with one layer of "crib-wire" spread over the top of the beams and bedded in the concrete. This reinforcing wire was No. 11 with 1½x4-in. mesh. The concrete was of 1 part cement, 2 parts sand and 4 parts Joplin chats.

The form was built so as to encase the beams in concrete and arched between, so as to have only a 4-in. slab on top, thus reducing the amount of concrete, and also the dead weight on the bridge.

The detailed cost was as follows: Two hundred and forty-eight sacks of cement, $86.80; lumber for forming, $51.55; cost of sand and chats, $111.17; cost of reinforcement (I-beams and crib wire), $146.15; cost of labor including excavation, building forms and mixing and placing concrete, $173.37; total cost, $569.04.

There was nothing charged to this bridge for transporting the material from the railroad station two miles away. That was done by the patrons of the bridge free of charge. Nor was anything credited to it for salvage on the form lumber, as this was moved to another bridge and used again. This bridge was built in September, 1914.

Very truly yours,

T. O. STANLEY,
Highway Engineer, Pettis County.

Sedalia, Mo.

Experience With Motor Street Flushers in Bethlehem, Pa.

Editor MUNICIPAL ENGINEERING:

Sir—We have had very good results with motor street flushers. We find them far more economical than the old style horse-drawn flushers because of the speed with which a given

area can be flushed when compared with the old system. Despite the shorter period required, the work is done just as efficiently and the overhead charge is considerably less.

I am unable to furnish you with any statistics showing comparative cost between the old and new system as our bookkeeping is not sufficiently detailed to permit of this but we are quite sure that the cost of cleansing a street block has been greatly reduced. We determine this from calculations made from test records heretofore made but which are not available at this time. I am unable to furnish you with a photo of the flushers as I do not possess any such photo nor do I know who does. I regret that I am unable to furnish you with more information but I can safely say that our municipal officers are highly pleased with their purchase.

Yours very truly,

Bethlehem, Pa. VICTOR E. TICE.

Light Canvas Strips for Floating Concrete Pavement

Editor of MUNICIPAL ENGINEERING:

Sir—During the past construction season a light canvas strip has been employed with good success for floating concrete pavement on several New York state highway contracts in Chautauqua and Cattaraugus counties.

A piece of 10 oz. canvas, about 3 ft. longer than the width of the pavement, was folded longitudinally to a width of about 18 in. and used instead of a heavier belt. By folding the canvas rounded edges were obtained which did not dig into the soft concrete.

In some cases the folded edges were left loose, and the ends of the strip rolled up to form handles for the workmen, and in others a more convenient belt was made by sewing down the folded edges and attaching wooden cross-pieces at the ends.

The operation of floating did not differ materially from the ordinary "belt method," but the light strips were handled with greater ease and rapidity than heavier belts.

The concrete was struck off with a screed of the usual type immediately after placing, and the surface floated at once with the canvas. Usually it was necessary to go over the pavement twice. On one contract, however, where the aggregates were particularly well graded and the consistency of the mixture very uniform, a single application gave an excellent finish. Floating was usually done by the same men that handled the screed. It was rarely necessary to use a hand float, except where joint strips projected above the surface.

The concrete was in all cases a 1:1.5:3 mix, using crushed stone for coarse aggregate.

Conditions Requisite to Good Results.

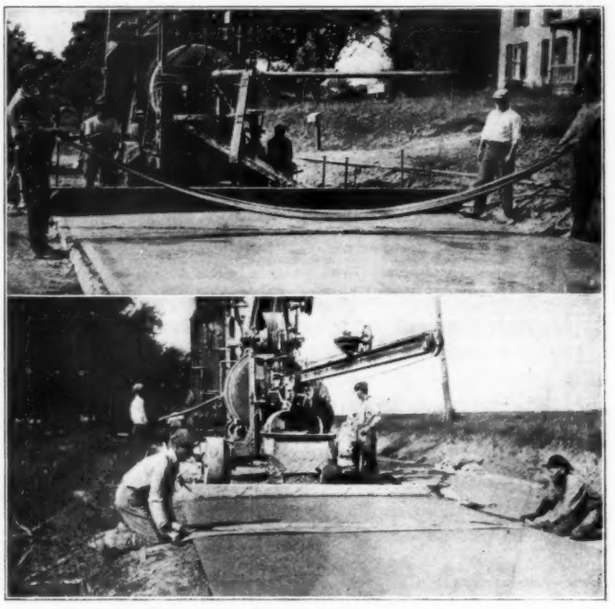
For satisfactory results in finishing pavement with the light canvas strip it was found that certain conditions must first be secured. All of these are essential, however, if a smooth surface is to be obtained by any method of finishing.

The forms must be straight and true and must be very carefully set. The top of the form guides the screed which shapes the surface.

The concrete should be fairly dry and of uniform consistency, in order to retain properly the shape given by the screed. A mixture in which the footprints of the workmen remain for several minutes without filling up is about right.

Careful screeding is of the greatest importance. If the screed "rides" the concrete, ridges result; if the concrete ahead of the screed is too low, depressions are formed. The canvas float will not smooth out these irregularities.

Provided the above conditions are fulfilled, a smooth and even finish can be easily and rapidly produced with the canvas. Very little mortar is flushed to the surface, rendering the pavement less liable to unsightly scaling under traffic. Time is saved, as except on steep grades and banked curves, where it is better to allow the concrete to become slightly hardened before finishing, the floating may be done immediately after screeding. No skilled labor is required, as the light canvas does not alter the shape left by the screed, and



FLOATING NEW YORK STATE CONCRETE ROADS WITH LIGHT CANVAS STRIP. UPPER—CANVAS STRIP USED FOR FLOATING JAMESTOWN-BEMUS POINT STATE HIGHWAY, CHAUTAUQUA CO., N. Y. LOWER FLOATING WITH CANVAS STRIP ON FRENCH CREEK —FINDLEY LAKE COUNTY HIGHWAY, CHAUTAUQUA CO., N. Y.

it is only necessary to make sure that it always touches the tops of the forms as it is worked back and forth along the surface.

These canvas strips were first used in this vicinity on the Jamestown-Bemus Point State Highway. Mr. John A. Wallace, assistant engineer, was in charge for the State Highway Department.

Very truly yours,

CHARLES T. FISHER,

Senior Assistant Engineer New York Commission of Highways, Jamestown, N. Y.

Experience With Tractor Grading Outfits in Miller County, Mo.

The Editor of MUNICIPAL ENGINEERING:

Sir—

Each of the two tractor grading outfits owned by Miller county, Missouri, consists of an Aultman-Taylor 30-60 gas tractor and a New Western No. 10 grader with a scarifier attachment; they were purchased in June, 1916, and during 1916 were operated under the control of the county court, but this year the court hired the tractor crew, and I have charge of the operation of the machines. The county owns the machines and furnishes the repairs, while the operation expenses, the wages of the crew, oil, etc., is met by the local road districts and private donations.

When the machines were first bought they were operated by the cheapest men that could be found, but that proved a failure, as an incompetent crew could not take the proper care of the machines and the repairs would soon amount to more than the wages of a good, competent crew. The crew at present consists of an engineer, a graderman and a helper; the engineer and graderman are paid 35 cts. per hour and their board, the helper 15 cts. per hour and board. When the machines are at work the local road overseer is along with his

crew to help pick the large rocks out of the road, blast out stumps and large stones that cannot be moved with the machines.

As to the cost per mile I can hardly tell, as we are here in the foothills of the Ozard mountains, the Osage river runs through the center of our county and a big part of our county is rough, hilly and rocky. About 50 per cent. of the roads in this county when graded have a natural hard gravel surface. Sometimes we can build a mile of road, with a 20 or 24 ft. roadway, in two days at a cost of about $50, and then the next mile may take from a week to ten days to grade at a cost of from $400 to $500; but as near as I can tell the cost per mile will average about $200, which includes the clearing of the right of way ready for the grader and the grading of the road, but does not include the culverts which, if built of concrete, will cost from $50 to $300 more per mile.

While our system of operating the tractors is not the best, it is the best we can do with our limited means; we need a cook house on wheels to move right along with our work to board the men; we are boarding them at private houses along the road at present. We can board them cheaper in a camp as a rule, and then they are always right at their work, and the engineer and graderman can go over their machines after working hours and save time, as the machines can be kept moving at least 10 hours a day, and an idle tractor is not building roads or making any money. Where the men board at private houses they may have to go two or three miles from their machines, and sometimes it will be an hour after working time before they get their breakfast and get their machines going, and the time of the balance of the crew is lost.

We have only used the machines for grading the roads, *i.e.*, cutting the side ditches and crowning the road. When the ground is hard and rocky we go over it first with a scarifier and loosen up the rock and dirt, and in case of stumps or large stones that the machine cannot move the overseer and his crew blast it out; then we take the grader and move the dirt into the road; we then use the scarifier again and keep repeating the operations until we have a good side ditch to carry off the water, and the road is well crowned.

We have a good gas tractor, but in a wooded-watered country I would advise the buying of a steam engine in place of a gas tractor, as they are cheaper to operate and more reliable, are not as apt to get out of repair and in this county steam engineers are more plentiful than gas engineers. We have had a lot of trouble trying to get good gas engineers, and wood and water is cheaper than gasoline and oil. Every community, however, would have to be governed by its own surroundings. My advice, based on our experience, would be never to buy a large grader with a scarifier attachment, but buy your scarifier or ripper mounted on a separate frame from your grader, as a machine that uses an attachment is hard to change from the grader blade to the scarifier, or vice versa, and you will find that in hard and rocky ground that the operating crew will not use the scarifier like they should, on account of its being hard to change. While a scarifier mounted will cost more than a scarifier attachment, it will give better satisfaction and will pay for itself in the time saved in changing the blades and the amount of work done. To those who contemplate buying a grading outfit, especially in a rough, rocky country, I will say do not be afraid of getting too large an outfit; I do not care how large and strong an outfit you get you will wish it was heavier and stronger when you get to using it among the rocks and hardpan gravel like we have down here in the Ozark mountains.

Yours for good roads,

S. C. KNIGHT,

Highway Engineer, Miller County, Missouri.

Tuscambia, Mo.

Gasoline Engine Efficiency

The Editor of MUNICIPAL ENGINEERING:

Sir—

Gasoline engines are used a great deal in and around municipalities for pumping water, for operating cement mixers, and for assisting contractors in general. They are used so much that it occurs to the writer that the following rule for estimating their mechanical efficiency will be welcomed. All that is necessary is to count the number of explosions made by the engine while running fully loaded and again when running without pulling any load at all. Subtract the number of explosions per minute when running at "zero load" from the number of explosions made while pulling "full load," and divide the difference by the number of explosions per minute while running fully loaded. The quotient is the "mechanical efficiency."

It is a fact that in engines of the hit-and-miss governing type each explosion represents a definite amount of gasoline or gas consumed. If the engine is running at no load and is exploding 22 times per minute, it means that 22 charges are lost per minute. If at full load the number of explosions becomes 122, it means that 22 explosions per minute are still lost and only 100 are utilized in doing useful work. It is therefore evident that the above rule is correct, and in this instance the mechanical efficiency is obtained by dividing 122 into 100, which gives us 82 per cent; 82 per cent is not such a bad efficiency, but if you can possibly make it 90 per cent, it should certainly be done. In order to obtain 90 per cent efficiency, however, the number of explosions while running at zero load will have to be as low as eleven per minute, which will be rather difficult of attainment in almost all engines of that rapidity of exploding.

Engineers need not be told how to reduce the friction in a gasoline engine. Good lubricant and plenty of it is a mighty good thing. Shafting must be properly aligned and babbitted. Nothing of a sliding nature must be too tight, nor must it be too loose if there is danger of knocking. In other words, everything must be "just right."

It is well to look into the matter of belt connection with considerable care also. A belt that is too tight will eat up a surprising amount of gasoline per day. It is much better to apply some good belt treatment to the belt and make it nice and pliable, so that it will not have to be maintained in a tight condition at all times. A very good belt test is to have the engine run at normal speed pulling nothing but the main drive belt and the main driven pulley. Suddenly close the needle valve and allow the engine to come to a dead stop. Count the number of seconds required for the engine to come to a dead stop. Then throw off the main drive belt entirely and try it again. If the belt is too tight there will be a very marked difference in the time required for the engine to come to a stop with the belt on and off. Do you get the idea? The longer the stopping time, the better.

The above two rules will be found of great value by anybody who has to do with gasoline, gas, steam or any other kind of engine. I have applied the "stopping time" method of testing even to electric motors and steam turbines. It is evident that the reasoning is based on sound logic. In fact, the writer has developed the mathematics of these methods to conclusive formulas that have checked very nicely in practical experiments.

Very truly yours,

New York City. W. F. SCHAPHORST.

Using Steam Jets to Thaw 3 Ft. of Frost

On a job handled by the Boston Excavating Co., 34 ins. of frozen clay was encountered. Embedded stones were more easily cut off than loosened. Of course this frozen crust resisted all hand tools and such ordinary means of thawing as the use of steam pipes under a canvas cover and live steam under a canvas cover proved a failure. By these means only

4 or 5 ins. were thawed out in 36 hours. The scheme successfully employed was to jet holes with a ½-in. open end pipe connected to a steam boiler by a ½-in. hose and forced steam pressure quickly melted a hole and forced small stones aside at the same time. As fast as these holes were made a ½-in. capped pipe containing four 1/8 in. holes was inserted and connected in series by short lengths of hose to steam lines run from the boiler. Twelve of these formed a series. These required 15 minutes to thaw out a section for the advancing steam shovel to excavate.

PLANT UNITS AND LAY OUTS

The One-man Collapsible Culvert Form

An adjustable culvert form, two sizes of which will build 39 different culvert openings, is being marketed by the Storms Manufacturing Company. It is called the One-Man Collapsible Culvert Form, being so termed because it can be handled and collapsed by one man. It completely eliminates the use of wood bracing in the building of concrete culverts, with either flat slab tops or arched roofs. According to its manufacturers,

VIEW OF COLLAPSIBLE CULVERT FORM IN CONCRETING POSITION.

it effects a considerable saving in the building of box culverts.

The forms, which are made of iron, come in two sizes covering cross-sections of from 13x15 ins. to 36x46. For larger culvert openings, the manufacturers advocate placing two forms abreast or stacked. For a 30-ft. length four sections are used spaced 4 ft. apart. If a concrete bottom is desired, the concrete is mixed stiff and supporting planks are laid on the green concrete. When building culverts too small for a man to enter wires are attached to the cross rod and center bar in order to collapse the frame and remove it from the culvert. To keep the lumber and frames clean tar paper is laid over the forms before deposing the concrete.

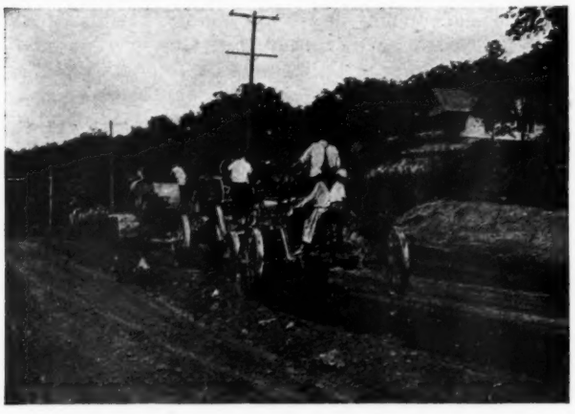
A number of these forms are in service and are said to be giving a good account of themselves.

It is also claimed that by using the One-Man Collapsible Culvert Form the contractor can build box-shaped concrete culverts in far less time, at less labor cost, less lumber cost, without danger of cracking, and produce a far better job in the bargain at a saving of 25 to 50 per cent as against the concrete culvert built by means of wood bracing which has to be sawed, fitted and nailed up and then torn out when the job is completed.

Conspicuous Success of Road Building Entirely by Machinery

In these days of labor shortage a recent road building test at Peoria, Ill., has more than passing interest. It was desired to show that road construction could be carried on entirely by machinery and an unimproved trail five miles long was selected for the purpose, since dubbed "the caterpillar trail."

For the grading the principal machines employed were a Western No. 10 blade grader and an Aurora reversible grader, both made by the Western Wheeled Scraper Company. They were hitched "tandem" and drawn by a Holt 75 H. P. caterpillar tractor. An improvised tool, known as a land leveller,



BLADE GRADER AND REVERSIBLE GRADER HITCHED TANDEM AND DRAWN BY CATERPILLAR TRACTOR.

preceded by a plow and tractor drawn, also was drafted into service to help move the material.

It is a notable fact that in 80 days with these machines 120,000 cu. yds. of earth were moved in the construction of a finished roadway 60 ft. wide, absolutely without labor in the sense in which the term ordinarily is used, and at a reported cost of only 4.1 cts. per cu. yd. Roadbuilders will be interested particularly in the astonishing performance of the large blade grader known as the "Western No. 10."

This was difficult hillside work, involving heavy cutting and filling. The average cut on the high side of the roadway approximated 8 ft. and there were some cuts of 15 ft., with corresponding fills. The cutting was done with the large grader and the smaller machine in the rear worked the dirt out to one side.

The blades of the "No. 10" are so adjustable that the machine can be operated on rough ground while the tractor is taking an easier course at one side. Starting some 8 to 10 ft. from the outer edge of the proposed side ditch, the big grader made a succession of cuts until the outside of the pro-

posed ditch was reached. At each cut a comparatively smooth place was left for the tractor to travel on during the next round, while the grader climbed a little higher. By a continued repetition of this process the banks were lowered to grade.

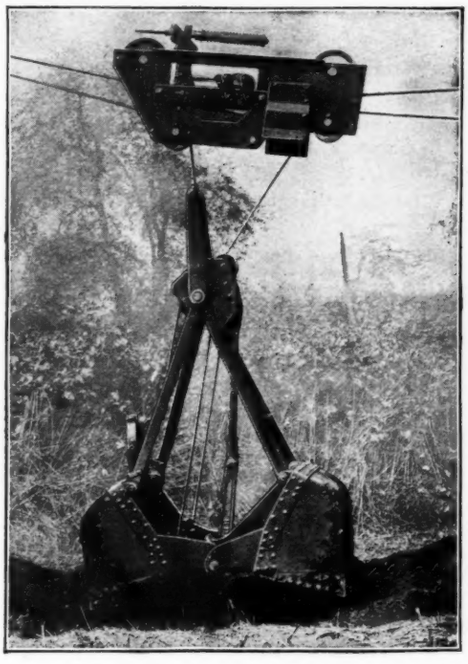
In one spot the grader sank into a mud hole so deep that the front wheels were entirely buried. It took the combined strength of two 75 H. P. tractors to pull the blade through. It was a remarkable endurance test.

In the light of a demonstration like this, to sidetrack the National Road building program on account of the labor situation, would seem the height of folly.

Locking Cable-Way Carriage for Operating Clam-Shell Buckets on Cable-Ways

Users of cable-ways operating scraper buckets or self-dumping skips loaded by hand oftentimes desire to substitute a self-loading bucket for the scraper, or skips, to extend the usefulness of the cable-way or to eliminate the labor of loading buckets. Sometimes the self-loading bucket will reduce a contractor's force on cable-way work by eight or ten men. In the past it has been necessary in such work to install additional engine drums and lines.

The Blaw locking cable-way carriage has obviated this expense. Its use enables the operator to use standard Blaw



VIEW OF LOCKING CABLE-WAY CARRIAGE.

clam-shell buckets on any ordinary cable-way designed for hand-filled buckets, without changing the cable-way engine or running additional hoisting or holding lines. This carriage also enables the user to construct a cable-way on which a clam can be operated by an ordinary two-drum non-reversible hoisting engine.

In the illustration herewith the bucket is shown suspended, in open position, from the cable-way carriage. The carriage itself is locked fast to the supporting cable by means of a clutch that is kept in engagement by the spiral compression spring. The bucket may be raised or lowered, closed or opened, without moving the carriage, by pulling or slacking on the appropriate lines.

When it is desired to cause the carriage to move, the bucket is closed and lifted and hung upon a hook pivoted to the carriage frame. The weight of the bucket then operates against the compression spring, releasing the clutch, and the carriage is free to move along the cable. By pulling on either one or other of the hoisting lines the carriage and bucket travel forward and back along the cable-way.

The system is completely automatic, operated by one man, at the hoisting engine.

Successful Demonstration of New Motor Truck

A demonstration of the Titan motor truck was made for the Pawling & Harnischfeger Co. on January 5. The truck and trailer used in making the test are here illustrated.

The grade out of the Pawling & Harnischfeger plant is 8 per cent. The driver tried to make this without skid chains and went half way up on second gear, but found, however, that in spite of the enormous pressure on the tires the wheels spun just the same. The hill was covered with snow and ice. The tires would melt the snow underneath and grab hold and pull the load up a couple of inches, but the driver finally stopped the load, applied the skid chains and started the entire 11½ tons from a dead standstill on the 8 per cent. grade. The machinery was taken from the P. & H. West Plant down to their South Plant, a distance of 55 city blocks, and the trip was made in 25 minutes. With the road conditions as they existed it would probably have taken 4 teams of horses fully two hours to make the same trip. The performance of this truck is all the more remarkable from the fact that the chassis was one of 4-ton capacity.

A Round Nose Curb Bar

The Havemeyer round nose curb bar is made with an inch radius and weighs 1½ lbs. per lineal foot. It is furnished both galvanized or ungalvanized, and is carried in stock lengths of 8, 10 and 12 ft. The manufacturers of this bar are in position to do most accurate bending. Besides stocking this curb bar in the Company's eleven warehouses, it is stocked throughout the country by various dealers and agents.

The form of anchorage in this bar is perfect, as the anchors are sheared from the web and occur every 6 ins. They extend 2¾ in. into the concrete, and are so flared and staggered as to give an excellent anchorage; especially is this anchorage of the proper type as there is a minimum of material extending into the concrete to split or weaken it, and at the same time offering a minimum of expansion and contraction and allowing no opportunity for the water to lodge and by freezing split the concrete.

ROUND NOSE CURB BAR.

Two types of forms are furnished for supporting the bar prior to pouring the concrete. These are a flat metal form and a spring wire support.

Economics of the Motor Truck Trailer

By Leigh Lynch, Sales Manager, Columbia Motor Truck and Trailer Company, Detroit, Mich.

The first difficulty against which the truck dealer runs in considering the trailer is the fear that the total sales of trucks will be decreased by its use, but this idea is not grounded on fact, any more than was the fear of the factory

workers of some decades ago that the incoming of labor-saving machinery, would decrease the amount of work and thus leave thousands to starve.

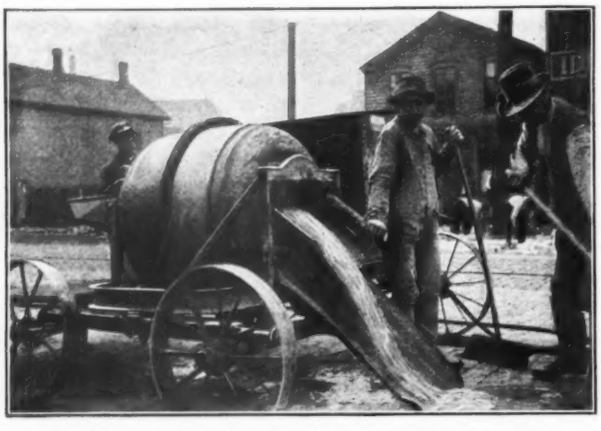
Every year records new inventions of labor-saving machinery, but the output of machinery, instead of decreasing, has increased tremendously. This line of reasoning is as true when applied to the motor truck as the fact that the motor truck is machinery. Discover and apply new methods of making the motor truck more effective, more profitable, and you will immediately increase the demand for the motor truck, just as surely as if you lowered the price of the truck. Yes, more surely; for in lowering the first cost of the truck itself you would certainly not be saving the consumer as much as if you lowered the first cost and the operation cost, too. And the trailer does both. Increasing the capacity of the truck by giving the user practically two trucks, the first cost is in reality lowered, and the operation cost for haulage largely decreased.

Another factor of considerable importance from the consumer standpoint is the fact that the motor truck will haul more than it will carry, even as a horse will draw more than it will bear. The trailer's efficiency is thus founded upon a law of nature. There is not the least doubt that the trailer will greatly increase the sales of the motor truck, even as it increases the motor truck's utility.

Contractor Adapts Building Concrete Mixer to Grouting

A contractor, George Czerwinski of Milwaukee, owning a building concrete mixer, secured a paving job on which it was necessary to have some kind of grouting machine. He didn't want to put money into a grouter just then, so by his ingenuity he made his mixer serve as a grouter.

The accompanying view shows how this contractor fixed up the mixer for grouting. He simply put the wheels on another pair of axles, set parallel with the drum, then he set the mixer with its axle ends resting on the new axles. This turned the mixer 90° and made it end loading. He then wired on a sheet metal discharge chute. This converted machine did fine work on a Milwaukee, Wis. paving job. When he finished this grouting job, he took off the extra set of axles and put the wheels on the stationary axles and pulled the mixer alongside a building about a mile away where he had considerable reinforced concrete to place. The whole operation of changing this machine back to a low charging mixer was accomplished in a few minutes' time.

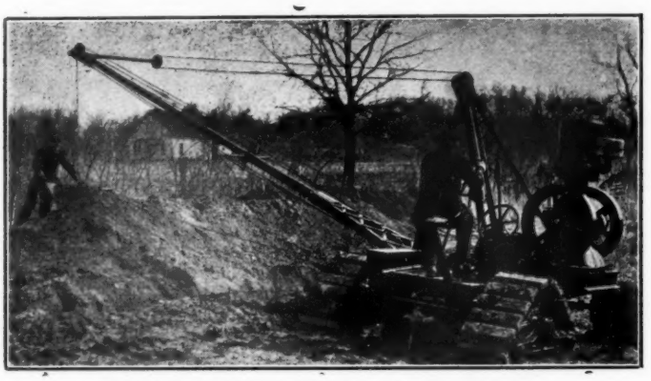


USING CONCRETE MIXER AS GROUTING MACHINE.

An Improved Trench Backfiller

The problems connected with the back filling of trenches and ditches have been a big item in the prompt completion of many contracts. Originally the very slow method of shovel and team was expensive and difficult to estimate. Then with the various "private inventions" for handling the material, accidents and delays were regularly occurring.

The Parsons Company, after a number of years of careful study and experiment, have met the difficulties and inaccuracies of backfilling with a machine known as their Backfiller No. 10. This machine has answered the situation so completely for many contractors, that the present detailed description is clearly warranted. The machine is manufactured with either the Parco traction or wheel drives and is the first to be introduced with caterpillars. The traction feature allows the machine to be used in soft ground where wheel traction would mire down and has been endorsed by a great many contractors throughout the country.



POWER DRIVEN TRENCH BACKFILLER.

The 30 ft., steel telescopic, swinging boom is another distinction which adds considerable to the desirability of the machine. The pipe construction permits the boom to be easily telescoped for any special length and is fitted to swing alongside for moving purposes. The machine is also designed so that the boom cannot be tipped under any operating conditions. An accessible worm gear boom hoist is provided for the boom suspension, attached in such position that it can be operated from the ground, the worm locking the device at all feature is the automatic scraper which has an angle adjusttimes except when the crank is turned. Another interesting ment allowing it to operate under most conditions without a man to guide it. Thus the operation of the machine is practically entirely controlled by one operator from a seat mounted on the rear end.

Such special features as the band brake on the traction drive—the rollers on the under side of the peak sheave housing, thus preventing the cable from leaving the sheave—the leather lined 15 degree cove clutches of the drums and the ball bearing collars—all combine to make the machine a very important factor in contracting work. The saving effected in the cost of filling trenches as compared with manual labor is very evident. In addition, the speed of operation and economy of labor have proven themselves to answer definitely the backfilling problems of former years.

Filtros Air Diffusing Plates Used in the Activated Sludge Process of Sewage Treatment

Filtros is a white, rigid, porous, mineral substance compossed essentially of silica, which might be termed an "artificial porous stone." The basic material is a carefully selected natural sand of exceptionally high grade averaging 99.6 per cent. SiO_2, which sand, by means of mechanical screens, is properly graded for the manufacture of the different grades.

The bonding agent employed is a synthetic silicate, fusing at temperatures above 2,000 deg. F., carefully prepared and proportioned in mixtures to produce desired results. All raw

materials entering into the composition and their manipulation during the process of manufacture are controlled scientifically to produce a product uniform in composition, structure, physical and chemical properties.

Filtros is a truly porous ware and it is not cellular. Its porosity is not obtained by any burning-out process and nothing is placed in it that is not a part of its finished state. The burning out of organic matter tends to produce a semi-closed cellular structure which may show a high percentage of voids and yet be permeable to only a limited extent, the result being a mass without uniform porosity and necessarily subject to the inherent defects of such a structure.

The plates are practically as hard as stoneware. These plates are uniform throughout and they are uniform with respect to each other. In order to insure uniform aeration over

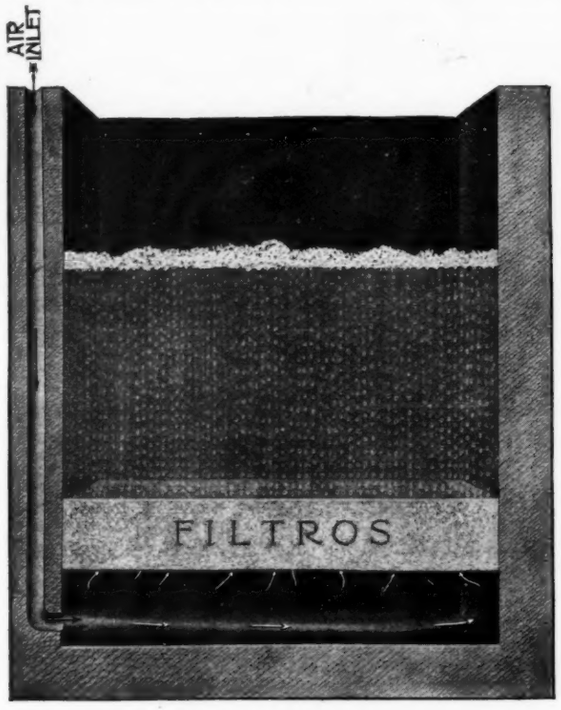


DIAGRAM SHOWING OPERATION OF FILTROS AIR DIFFUSING PLATE.

a given area covered with plates, each plate is tested for its air passing capacity, and only those plates that pass like volumes of air are furnished for an installation. The illustration herewith gives an idea of the uniform porosity.

The plates are marketed in the standard size, 12x12x1½ ins. Plates of this size have been installed in the activated sludge tanks at Milwaukee, Cleveland, Urbana, Ill., Chicago, Ill. (Sanitary District), Houston, Paris and San Marcos, Texas, Pasadena, Cal., New Haven, Conn., Worcester, Brockton and Lawrence, Mass., and in other municipal, tannery and stockyards disposal plants.

As the readers of this journal noted in the article in the "Water Purification and Sewage Treatment" Section of the December, 1917, issue, of all the different types of air diffusers tried out by the Milwaukee Experiment Station, the filtros plates were found to be the most satisfactory. The plates are manufactured and marketed by the General Filtration Company, Inc., Rochester, N. Y.

A Simple Recording Instrument for Measuring Water or Gas to Find Leakage

The Lanham Monograph is an accurate and simple form of recording instrument for use in connection with Pitot tubes for measuring the flow of water or gases through mains or conduits. It was devised a number of years ago by Paul Lanham, in charge of water waste surveys in Washington, D. C. Extremely satisfactory results accompanied its use so it was placed on the market by the Water Works Equipment Co. of New York. The Pitot tube as used in the Monograph is an especially designed form which has features adapting it to the uses peculiar to this instrument, and superior to types heretofore used for this class of work.

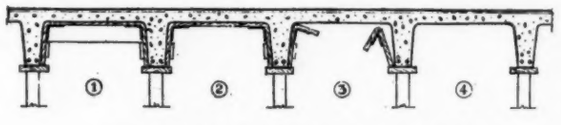
Perhaps the most important application of the Monograph is upon discharge mains from pumping stations. When so used, it gives a graphic chart showing the hourly and daily rates of flow delivered by the pumps, and these properly interpreted are of the greatest value to water works engineers, enabling them to determine whether the pumps are delivering their proper share of the water, whether the capacity of the discharge mains or pumps is being reached, the time and duration of abnormal rates of consumption, and numerous other points of interest and value.

Upon gravity supply mains, it serves as a graphic meter showing total quantity of water consumed, and hourly and daily variation in the rate. It permits a study of these rates to determine the effect of fires, main breakage, waste, or other abnormal conditions on the water supply. High percentage of flow at night when legitimate uses are at a minimum shown by the records indicate waste of water, a matter becoming of greater importance each year.

The portability of the Monograph permits of its use as a district meter in the analysis of the water consumption throughout the supply system. If conditions warrant the system may be divided into a number of districts and measurements made. These districts may be in turn subdivided and measurements on the subdivisions. The analysis along this line may be carried to the smallest territories, localizing the consumption or waste and accounting for the flow.

A Collapsible Wood Joist Form

The collapsible wood joist form here illustrated is made of the best quality of 1 in. dressed lumber. Span No. 1 shows the completed form in place; spans Nos. 2 and 3 the process of removing the diaphragm and insert, and span No. 4 the smooth concrete surface after removal. The forms are furnished for any depth or spacing of joists specified. During the first 48 hours after pouring concrete these forms provide an absolutely rigid support. Any tendency to vibration, due to accident or in the process of ordinary framing being done on top of the slab, will be resisted by these forms and no injury can be done the rapidly setting concrete. At the end of

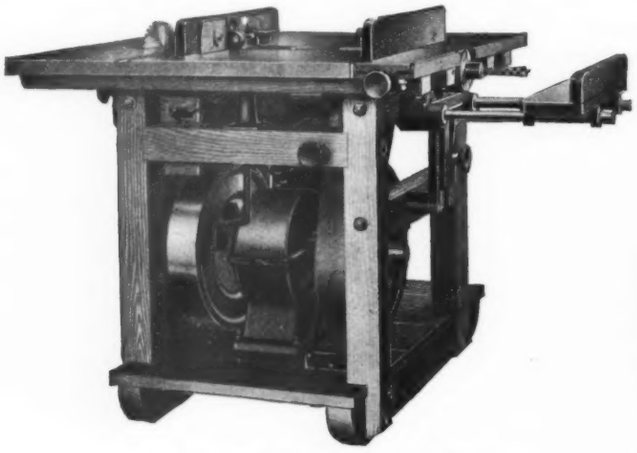


COLLAPSIBLE WOOD JOIST FORM.

this period the forms should be removed to allow the free circulation of air around the bottom and sides of the slab and joist. The price is practically the same for any depth or width of forms selected. Some of the advantages of a solid wood form are: The time saved in setting re-inforced steel, in doing all kinds of heavy carpenter work and in the speed and security with which "plumbing sleeves," "outlet boxes" and "pipe fitting" may be done. These forms permit holes to be cut, nails to be driven, or any mechanical operation customary in the use of wood. These joist forms are manufactured by the Collapsible Joist Form Co.

The Eveready Saw Rig

The contractor who has an Eveready on his job has a planing mill at his command. It is a complete machine. This Ransome-Oshkosh machine, here illustrated, performs eleven operations; cross cuts, rip saws, jig saws, band saws, tenons,



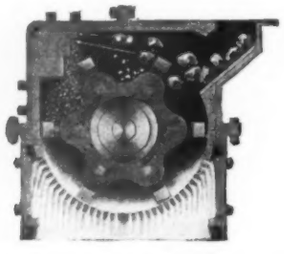
A GENERAL PURPOSE SAW RIG.

mitres, joins, bores, mortises, grinds, grooves, rabbets and sands. While the machine is substantially constructed it is light and easy to handle so it possesses the advantage of portability. It is claimed that it will do more in an hour than a man can in a day.

A Portable Crusher Popular with Road Builders

The K-B pulverizer can be obtained ready mounted on a truck. With such an outfit stone can be crushed wherever most convenient. Contractors and road builders show preference for this style of mounting.

The K-B pulverizer is an all-steel hammer mill built for service and durability. It operates at a low cost. It consists essentially of a large outer steel casing, lined with manganese steel plates, within which six U-type hammers are suspended from a central shaft. As the material is fed into the hopper the hammer whirling around at the rate of over 1,000 r. p. m., catch it and hurl it against the breaking blocks. The rebounding fragments are caught by the succeeding hammer, and again shattered against the steel blocks. For pulverizing



ESSENTIAL ELEMENTS OF THE K-B PULVERIZER.

moderately hard materials there are several advantages claimed for a hammer-mill over other types, as follows:

1. It takes a larger piece and crushes it to a finer product than any other single machine. In some cases it eliminates the work of the preliminary crusher; in other cases it does away with additional screens and separators.

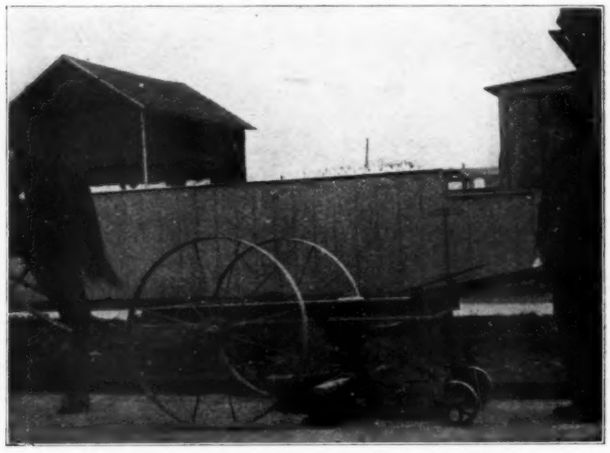
2. Both the initial and also the operating cost of a hammer-mill is less than that of other types of reduction machinery. This is because it is simpler in construction and consumes less power than other machines doing similar work.

3. The K-B Pulverizer will often handle wet or damp materials, thus eliminating the cost of drying before pulverizing.

The machine is belt-driven and any type of engine or electric motor can be used to run it.

A Satisfactory Sand-Sweeping Machine

The sand-sweeping machine here shown, used by the Asphalt Block Pavement Co., Toledo, Ohio, is horse-drawn and derives its power from the large driving wheels, which, operating through the sprockets and chain and bevel gears,



SAND SWEEPING MACHINE USED ON PAVEMENT CONSTRUCTION.

causes the brushes to rotate about the vertical shaft. The rotary movement of the brushes, as the machine advances, sweeps the sand into the cracks betwen the blocks most effectively. When it is desired to move the machine to another job, the clutch can be thrown out and the brushes raised. It can then be moved by hand if necessary.

Heltzel "Lightning" Loader Skips

In these days when the contractor is so concerned in saving labor and time, owing to the scarcity of the one and the value of the other, loading devices are proving exceedingly helpful.

The Council of National Defense, working in collaboration with the Government, have increased the demurrage charges on cars to such an extent that the contractor is forced to pay a good stiff price for any delays in handling his material. It is, therefore, imperative, not only from a patriotic but from a selfish standpoint, to use every means of reducing the cost of handling material by the installation of every practical and economical means available.

The "Lightning" Loader Skip is offered for this specific purpose. It is easily and quickly attached to any type of railroad car. It decreases enforced idleness by ever inviting the shovelful. It instantly stops delays. It keeps the men on the trucks and teams constantly on the move. This loader skip is adjustable to height and consequently a truck of unusual height is not difficult to load.

The objection to devices of this kind, in the past, has been the excessive weight and difficulty in installing on the car. This has been eliminated by the unique construction offered by the Heltzel Steel Form & Iron Co., of Warren, Ohio, in the loader skip here described. The pan or tray, holding the materials is slid out over the top of the two steel structural brackets, strongly constructed, and is held in place by steel shoes which fit into the upturned end of the bracket. The steel sideboards and doors are independent units and are attached as such. The door opens by gravity, and acts as a re-

tard, preventing an overflow of materials across the wagon or truck, thus eliminating spilling of the materials.

The loaders are in use by the United States Steel Corporation, the Standard Oil Company, the Westinghouse interests, and by the U. S. Government, principally on cantonment and other rush construction jobs.

ADVANCE INFORMATION ON BIG JOBS

The Proposed Military Roads of Texas

By George A. Duren, State Highway Engineer, Austin, Texas

The great need of military roads has suddenly made itself manifest to the War Department as well as to the general public. It is now a matter of common knowledge that the excellent highways of France made it possible, with the use of motor trucks, to change the results of the war from a sure defeat of the Allies to a final victory.

Texas Has First Hand Knowledge of Importance of Military Roads

Pershing's expedition into Mexico brought clearly to our attention the important role that motor transportation would hereafter fill in modern warfare. Great troop movements have already taken place in Texas over our highways, and it is telling no military secrets in calling attention to the fact that the Sixth Regiment of Cavalry was moved over them from Marfa to San Antonio, a distance of 450 miles, and that at the same time a full regiment, being the Eighth Cavalry, was moved over the highways from Fort Bliss, at El Paso, to Marfa; and that a regiment of engineers went overland from San Antonio to Corpus Christi; and that an immense army wagon train traveled overland from Fort Sam Houston, at San Antonio, to Fort Sill, at El Paso; and that at this time a trip is being made by motor ordnance repair trucks on a tour of the Texas border forts.

Points That Should be Connected with Military Highways

There is now a constant stream with traffic of troops and equipment, and military traffic over our State Highways. On account of the enormous resources of Texas and on account of its climate, enormous numbers of soldiers are being trained within the borders of the state. Large bodies of men and a tremendous amount of army equipment with vast expenditures of money are now found on every hand within this state. Some of the points of mobilization and training that should be connected up with first class military highways without delay are as follows:

Fall Field, Aviation Camp, Wichita Falls; Love Field, Aviation Camp, Dallas; Taliaferro Fields, Nos. 1, 2 and 3, Aviation Camps, Fort Worth; Camp Bowie, Army Post Headquarters of 36th National Guard Division, at Fort Worth; Camp McArthur, at Waco; Hicks Field, Aviation Camp, at Waco; Camp Logan, Houston; Fort Crockett, at Galveston; Camps Travis, Bullis, Stanley, Morse, Fort Sam Houston, at San Antonio; Aviation Fields: Kelly Field No. 1, Kelly Field No. 2, Brooks Field, and Balloon School, San Antonio; S. M. A. Aviation School, at Austin; Signal Corps School, at Bryan; Fort Brown, at Brownsville; Fort Ringgold; Fort McIntosh, at Laredo; Marfa, Headquarters Border Guard; Army Post at Fort Bliss, El Paso, Headquarters of Western District of Southern Department; and Ship-building plants at Houston, Orange and Rockport.

All of the most important points of concentration of troops in the state, as mentioned above, with a few minor exceptons, are situated in the heart of the industrial and agricultural portion of Texas, along with the greatest concentration of the population of Texas.

The System of Military Highways Planned

The map shown herewith outlines a system of military highways planned for the purpose of conserving the resources of Texas and for the purpose of concentrating our efforts in order to accomplish the construction and maintenance of the most vital arteries of motor vehicle transportation of the state. In my opinion, the highways shown on the map are of vital importance to the military and also to the industrial welfare of the state of Texas, and to the nation.

The improvement of those highways designated on the map by solid lines, is an immediate public necessity. The entire system of highways shown constitutes a system of important military highways, but in order to accomplish the desired results we must begin with the most important and concentrate our efforts on these for the fulfillment of our purpose. The roads shown by parallel lines are of great military and economic importance, but their construction should not be allowed to interfere with the construction and maintenance of the system shown in solid lines until their construction is accomplished. We should refrain from interfering with shipments of coal and other shipments essential for war purposes. Our plan may be submitted to the War Council for their consideration, and if, in their opinion, they deem it necessary or desirable to co-operate, we would gladly receive any assistance they may extend. I suggest that they do extend to us aid either by alloting to this work necessary railway service, or by alloting, in aid of this work, funds.

Raising Funds

In order to raise funds for the construction of this system of military highways, I suggest:

(1) That the military importance of these roads is sufficient to warrant their construction out of Federal funds as a war measure. The War Department is fully advised of the facts relative to army camps, aviation fields, etc., served by this system and we respectfully urge that it take over the construction and maintenance of this system or a system of its own designation.

(2) The national importance of these roads as post roads is sufficient to warrant a liberal interpretation of the law by the Office of Public Roads and Rural Engineering and a liberal grant of shipping facilities for their construction.

(3) This system is of sufficient state importance industrially and as a measure of home defense to warrant not only the most liberal interpretation of the State Highway Act of 1917, but of sufficient merit to warrant a state bond issue.

(4) Each part of this system lying within the respective counties and cities traversed is of sufficient local importance as an economic and industrial measure to warrant its construction entirely out of local funds.

Suggested Petitions

I am of the opinion that petitions, if strongly urged, as follows, might be granted:

First, petition to Secretary of War Baker and to Railway Director McAdoo, that necessary railway facilities be allowed for construction and maintenance of this system of roads and that the improved parts of them adjacent to army posts that

have been destroyed by army traffic be restored and maintained by the War Department.

Second, to the Secretary of Agriculture, that this system be declared eligible to Federal aid allotments in all of its parts since they are either used as post roads or will probably be used for carrying United States mails after construction, and to petition him that on them no further formalities be required in the way of proof from postmasters and mail carriers in certificates, etc.

Third, to urge the state officials to act in accordance with the most liberal interpretation of the State Highway Act, since, as I understand, it was the intent of the framers of the State Highway Act of 1917 to restrict aid to the construction of ten miles of highway with state aid in any one county in any one year not to exceed one-fourth the total cost of construction of forty or more miles in the county.

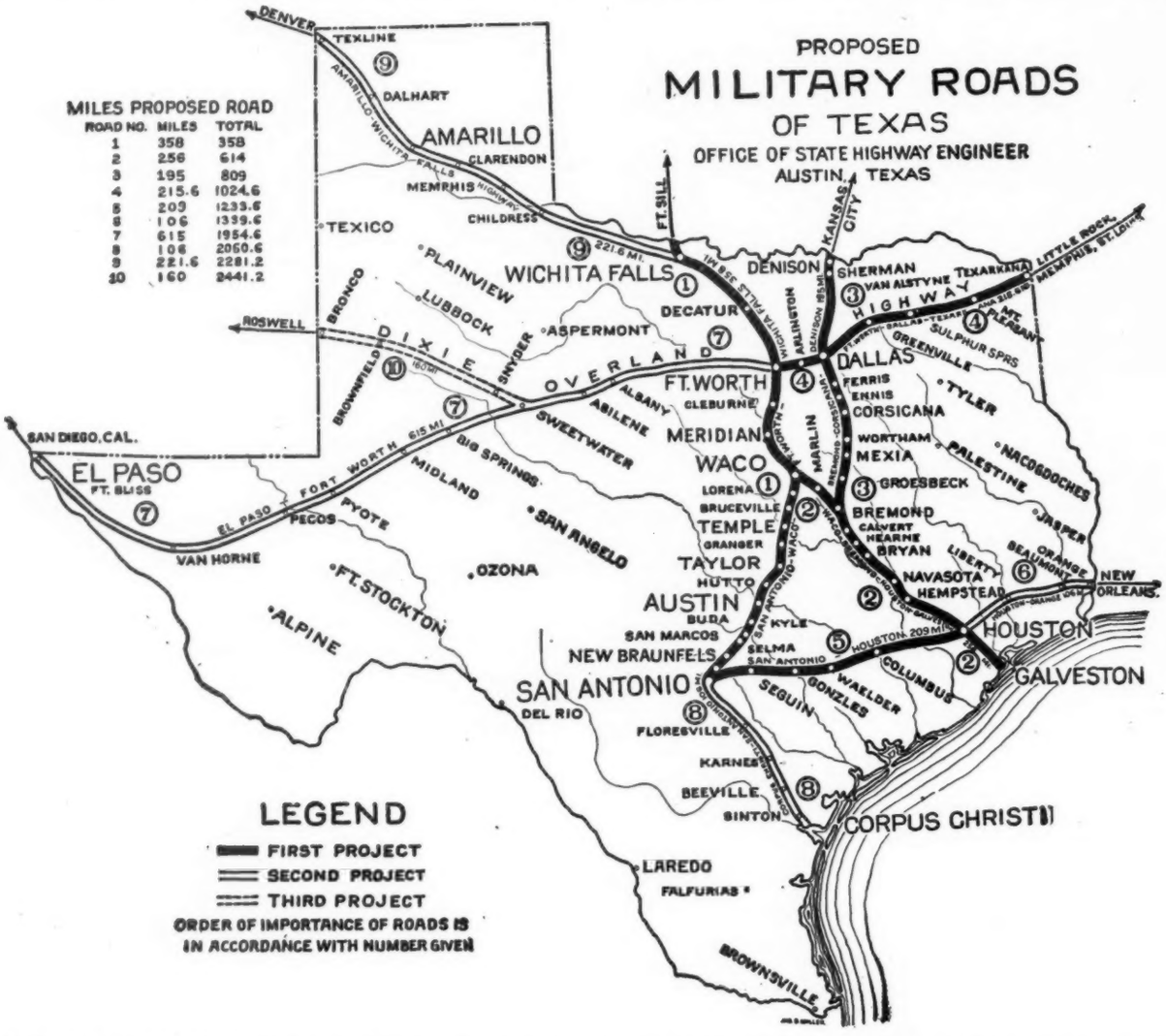
Federal Aid to Counties

I should be glad to recommend to the State Highway Commission that Federal aid be granted out of available Federal aid funds to cover not less than 40 per cent. of the total cost of the system and that state aid be granted to an amount of between 20 and 25 per cent. of the total cost of them, except where it would exceed one-fourth the cost of building the most expensive forty miles in the county; and I would recommend that county bonds or warrants be issued to cover the balance of cost of construction.

The recommendation of the Federal Reserve Banking Board that improvements requiring bond issues be suspended during the war, I endorse in all things except for the necessary bond issue and road district bond issues required to accomplish the construction of this system of highways. I suggest that these bonds be designated as "Liberty Highway Bonds" and that they be sold in Texas, if possible, and that an attempt be made to sell them in accounts pro rata with the assessed wealth of the individuals, placing 40 per cent. or more of the bond issue of the county in question with the people of the county and placing 60 per cent. with the people of the state of Texas pro rata with their assessed wealth.

Organization

I recommend that the proposed construction be in charge of the State Highway Department subject to inspection and general supervision by the Office of Public Roads and Rural Engineering. I would call on the county officials to turn over to the State Highway Department for their control in the proposed construction all county road machinery, teams and other equipment, or as much thereof as may be required. Such counties to be reimbursed by schedule of rental charges such as would be equitable, and that contractors' organization and equipment be in like manner used on same basis of pay as that of counties furnishing similar organization, tools and equipment. In this connection, the free labor employed thereon might be advantageously regulated on a military basis and trained to the duties of highway engineering corps for active war service. If found advisable, state prisoners could be used and in addition thereto county prisoners wherever legally possible. For later consideration, the use of



Federal prisoners may be considered with the view of providing employment for our future supply of war prisoners.

The first project contemplated includes 1,233.6 miles of highway. The second project for approximately the same mileage. All of these highways lie near and adjacent to one or more railways. Numerous gravel pits and rock deposits are found adjacent, and this system of roads can be constructed with a minimum expenditure; in car miles, in team miles, in labor days and in materials used. This system is in part already constructed and the completon of it for each dollar expended will accomplish as much or more in results as would the construction of any other highway in the state. I am of the opinion that we could do no more patriotic thing than to accomplish the construction of this project without delay.

News of Prospective Work From State Highway Departments

The present outlook for highway construction work is here given as reported to the editor by officials of the state highway departments:

Illinois

Clifford Older, Chief Highway Engineer, writes as follows:

"Aside from the restrictions which war conditions place upon all construction work, the prospect of highway improvement in this State was never better than at the present time. The funds available from Federal Aid, county bond issues and the regular State aid program amount to approximately $10,000,000 and no doubt under normal conditions, only the ordinary difficulties would be encountered in arranging for the improvement of the roads this amount would cover.

You are no doubt familiar with the plan proposed at the Richmond convention of the American Highway Officials Association which, in brief, provides that each State Highway Department furnish to the executive committee of the Association, an outline of the maintenance and improvement work contemplated for 1918, listed in the order of importance of the various projects. The executive committee of the Association will then present the entire matter to the Highways Transport Committee of the Council of National Defense and it is believed that in this way a logical plan for highway improvement, which will fit in with the needs of the Federal Government, may be carried out.

It seems to be generally recognized that highways connecting industrial centers with each other and with shipping terminals may be used to great advantage during the period of the war. It seems, also, that many improvements may be made during the period of the war which will provide highway transportation facilities of this character that do not exist at the present time. We are at the present time engaged in shaping our program in so far as the restrictions on funds will permit in accordance with the above outlined plan.

New Hampshire

Fredric E. Everett, Commissioner New Hampshire State Highway Department, Concord, writes:

The State has an appropriation of $200,000 for trunk line construction, besides an annual appropriation of $125,000 for State Aid. All work, however, both trunk line and state aid is done on a joint account basis or really a state aid basis. The difference between trunk line construction and state aid construction is that the state pays a larger proportion of the entire cost on trunk line work than they do on state aid work.

Just what will be done the next year it is impossible at this time to say as we cannot tell what towns will apply for state aid until after their annual town meeting which, in New Hampshire, comes in March.

Last year the state built only about two-thirds as much road as they did the previous year and there was a larger appropriation. The state is prepared to meet all the towns in the matter of appropriations and to proceed with the work as fast as possible.

The matter of road material does not seriously affect us, as we use most all local gravel and stone in our construction work. However, cement, binders, etc., have to be shipped from outside of the state. Priority orders and embargoes would affect us in so far as they refer to these materials.

We are making plans for our maintenance work, and will do everything possible to keep the roads already built in good condition.

Ohio

R. C. Watts, Office Engineer, writes:

The demand for road improvements is greater than ever, but the prospects at this time are not first class for placing contracts. Therefore, we are unable to give you what will be improved this year.

We are, however, proceeding as usual to plan future work —which is done in cooperation with the counties, program for which is not as yet completed.

West Virginia

T. S. Scanlon, West Virginia State Road Commissioner writes:

We have laid out in this State practically 4,600 miles of what the law describes as "Class A" roads. This is an intercounty system, laid off to connect every county seat and important commercial center with every other county seat and important commercial center. We approximate the cost of this 4,600 miles to $100,000,000, $20,000,000 of which has been provided and partially spent, possibly more than one-half of it. The counties of our State have this year laid a levy and are now collecting it; known as "Class A levy," of about $2,000,000, and this, you understand, is outside of a special levy that each county may lay for the coming year for the purpose of building lateral or district roads. We expect a number of the counties to bond themselves for road purposes during the early spring, probably to an amount that will be at least as much as three or four millions of dollars. This combined with the money on hand in a number of the counties and the "Class A levy" above mentioned and which has been laid by all of the counties will give this State considerable money to spend in the direction of road building and road improvement in the year 1918.

We will have besides this, in the way of State and Federal Aid, probably five or six hundred thousands of dollars that will be distributed pro-rata among the counties, based upon the mileage in each county of the "Class A" roads above mentioned.

At this time we cannot give you much detail as to what is going to be done, as we are not sure what is going to happen in connection with transportation matters. We feel satisfied from the correspondence that we have had with the National regulating power that as soon as possible road materials will be taken off the restriction list. However, we have but very few counties in this State that we cannot spend considerable money in, in the way of grading and drainage and we have in very many sections of the State good local material outside of probably the binder, should we want to use other than water bound construction.

We feel sure that the people all over the country have become awakened to the necessity of making good roads, especially the through system like the one we have laid out in our State and our people are not an exception to this rule. The writer has had long experience in road building in several of the States and he can positively state that he has never seen as much good road sentiment among the people in any community that he happened to be in as among the people of this State at this early stage of road construction in West Virginia.

So you may rest assured that West Virginia will go ahead in this year of 1918 and do at least as much road building as in the past years, if not more.

Indiana

Wm. S. Moore, State Highway Engineer writes:

The Indiana State Highway Commission has sufficient money in sight to build approximately two hundred miles of Main Market Highways. We are preparing plans and specifications and making the surveys for these improvements, and are expecting to carry out, if possible, all of this work in 1918. We feel that no work should be done, at this time, except on the Main Market Highways, and we are, therefore, centralizing our forces on these roads. We think that now is not the time for promiscuous road construction, but we cannot allow main roads to become impassable, and for that reason we expect to proceed to put these roads in repair and improve same wherever it is possible to obtain material.

We are making an extra effort to use local material as much as possible.

We are submitting to the Transport Committee of the National Council of Defense a list of these main roads, together with the amount of material which will be required to be shipped for maintaining and improving during the year of 1918, and asking that the embargo on open top cars for this road material be lifted.

You will recall that at the last session of the State Highway official meeting, which was held in Richmond, Virginia, which requested the Highway officials to furnish information as above stated, and this Commission expects to comply in every way with these resolutions and to co-operate with the State Commission of Defense in any program which they think advisable.

Pennsylvania

J. Denny O'Neil, Highway Commissioner of Pennsylvania, has completed a tour of the various counties, which was taken for the purpose of holding conferences with Boards of County Commissioners and other local authorities regarding future road construction and improvement and to secure cooperation, if possible, in a plan, whereby they will join with the State in financing the improvement of highways. In most instances Commissioner O'Neil was successful and an effective road-construction plan is being worked out by which many miles of important roads in the State will be reconstructed, the State and local authorities each paying one-half of the cost.

Despite existing abnormal conditions—scarcity of men and the high cost of everything which enters into the construction of an improved road, together with the lack of freight car facilities for the haulage of road materials—it is Commissioner O'Neil's intention to go ahead with the plans which he is formulating with local officials throughout the State, for the improvement of roads that, eventually, will link up into a complete system which will connect all of the county seats.

With so many factors militating against a big road construction policy, Commissioner O'Neil states that it is hard definitely to say at this time what the Department will be able to undertake along construction lines during 1918. But he is of the opinion that all matters should be shaped up in such a manner that when conditions begin to assume a more normal aspect, there will be no delay in the commencement of work to improve those roads which are to form a part of the proposed system.

Commissioner O'Neil has declared for a strong maintenance policy, stating that all roads which have been built must be maintained adequately at all costs.

Virginia

G. P. Coleman, Road Commissioner of Richmond, Virginia, writes:

The plans for the coming year for road work in this State have not assumed definite form. We are, however, recommending to the Legislature our usual appropriations for the coming year; that is

State money aid	$200,000
State convict labor aid	250,000
Maintenance (approximately)	600,000
Contingent fund for this department	38,000
To meet the Federal allotment	330,000

In other words, it is our plan to carry on as far as possible our usual amount of road work, and in addition thereto between six and seven hundred thousand dollars of work as covered under the Federal aid bill, believing that in doing this we are offering the best service we can to the nation for the successful prosecution of the war, since we feel that the highway transportation in America will play an important part in the ultimate victory for this country in France.

North Carolina

W. S. Fallis, State Highway Engineer, Raleigh, N. C., writes:

The following outline is of work that we hope to do under Federal aid during the next eighteen months, naming the counties in which construction is proposed and the roads:

It is the purpose of the State Highway Commission first to complete the worst sections of through state roads, with the best construction the financial situation in the sections of the state through which the roads of the state are to be built will permit.

A road through Person county to the Virginia State line, a distance of from 25 to 30 miles is projected, and we expect to complete this, if bonds can be sold by the county to provide for the county's share of this work.

A road in Wilkes county, which is a link of a through road connecting Tennessee with northwestern North Carolina will be built. This road will probably cost somewhere in the neighborhood of $40,000, and is about 40 miles long.

We are nearing the completion of a road crossing the Blue Ridge in Henderson county known as the Hickory Nut Gap road, one of the most scenic roads in that section of the state of North Carolina, passing the famous Chimney Rock and across Hickory Nut Gap, bringing into full view at many points the famous mountain peaks of this section, among them Mt. Mitchell, one of the highest peaks of the Blue Ridge mountains.

A road is also being constructed across the Blue Ridge, and is nearing completion, along the Southern Railroad through McDowell county. This is also a beautiful piece of mountain scenery, and follows that wonderful bit of railroad engineering that carries the Southern Railway across the Blue Ridge and down the French Broad river to Knoxville, Tenn.

Southwest of the Buncombe county line, along what is known as the Murphy branch in the Hiwassee, Tennessee and Tuckaseegee valleys, much road construction is in progress, which when completed will open up to the tourist a through road from Asheville to Atlanta, and make it possible for him to visit what is perhaps the most beautiful mountain scenery in all the eastern part of the United States.

Guilford and Mecklenburg counties have ambitious programs for road construction during the coming summer. A bond issue of one million dollars is being agitated in Guilford county, and much bituminous road will be constructed in Mecklenburg county during the coming summer.

Mecklenburg county is the leading, or rather the pioneer road county of the South, having constructed hundreds of miles of waterbound macadam road during the days when waterbound macadam represented the best type of road construction. Owing to the failure of this county properly to maintain these roads their system has become practically worn out, and reconstruction on a large scale must be undertaken.

Eastern North Carolina is beginning to wake up also to the value of making expenditures for the construction of roads, and Wake county is contemplating a considerable expenditure for concrete road work; and some concrete road work is being planned in Lenoir county. Beaufort county is also discussing the expenditure of considerable sums on this class of work.

Eastern North Carolina, especially the Coastal Plain, is practically devoid of suitable road surfacing material, and it seems likely that they must resort to high class road construction as rapidly as the financial situation will permit.

New Hanover county has already constructed roads that are perfectly satisfactory to the traffic of this county, which is largely pneumatic tired traffic, and iron shod traffic of rather light unit weight. They have excellent roads, however, of bituminous surfacing and bituminous treatment, and taken as a whole are probably better fixed in roads than any other county in the State.

The aggregate of road construction in other sections of the State will amount to between three and four million dollars during the coming year, if the plans now being promoted are carried out.

The Tex-O-Kan Highway Organized

Another interstate highway, called the Tex-O-Kan highway, has been organized. The organization meeting was held at Abilene, Texas, recently. The highway will extend from San Antonio, via Kerrville, Paint Rock, Ballinger, Abilene and Quanah, Texas, to Altus, Okla., and thence into Kansas. Delegates from every county along the route attended the organization meeting and indications are that within a year this will be a hard surface roadway from one end to the other.

The greater portion of the route will be eligible for both federal and state aid. Officers of the Tex-O-Kan Highway Association are: J. A. Walker, Altus, Okla., president; Hon. E. M. Overshiner, of Abilene, vice-president, and J. W. Golston, of Quanah, Texas, secretary.

Eight Southern States Will Spend $74,000,000 on Road Construction This Year

Estimates based on figures from the highway departments of eight southern states indicate that $76,000,000 will be expended by those states on the construction of permanent highways and bridges in 1918, says the Southern Construction News.

The states included in the list are shown in the following tabulation with the estimate of the amount to be spent by each state:

Alabama	$4,000,000
Arkansas	5,000,000
Louisiana, available	9,000,000
Mississippi	2,000,000
Missouri	6,000,000
Oklahoma	2,000,000
Tennessee, from all sources, available	16,000,000
Texas, from all sources	30,000,000
Total	$74,000,000

Alabama

In Alabama it is safe to predict that more than $1,248,000 will be used in road construction since this amount of federal aid is available. The usual state aid is $154,000. Counties taking state aid put up dollar for dollar. Everything considered it is probable Alabama will spend $4,000,000.

Arkansas

In Arkansas construction is under way or the organization is perfected to a point ready to begin construction on 868.88 miles of road, representing an expenditure of $5,965,239.21. Throughout 1917 petitions for surveys have come in faster than the department has been able to furnish engineers, and as yet there seems to be no let-up in requests for same, there being now on file petitions asking for surveys of 250 miles of road.

Louisiana

In Louisiana, in addition to federal and state aid funds, $7,825,000 in bond issues have either passed or elections have been called as follows:

Vermillion Parish	$ 600,000
St. Mary Parish	400,000
*Terrebonne Parish	150,000
*LaFourche Parish	150,000
*St. James Parish	250,000
*West Baton Rouge Parish	150,000
*Point Coupee Parish	170,000
Lafayette Parish	300,000
*Acadia Parish	400,000
Evangeline Parish	140,000
*Jeff Davis Parish	500,000
*Beauregard Parish	600,000
*Calcasieu Parish	900,000
*Allen Parish	115,000
*Vernon Parish	240,000
*Sabine Parish	40,000
*Natchitoches Parish	250,000
*De Soto Parish	250,000
*Red River Parish	150,000
*Caddo Parish	260,000
*Bossier Parish	150,000
*Grant Parish	150,000
Winn Parish	300,000
*Rapids Parish	250,000
*Quachita Parish	500,000
*Avoyelles Parish	100,000
*Caldwell Parish	140,000
*Assumption Parish	40,000
*Ascension Parish	80,000
*Baton Rouge Parish	100,000
Total	$7,835,000

*Have already been passed and the money is ready.

Mississippi

X. A. Kramer comments on conditions in Mississippi as follows:

"Approximately $7,500,000 is being expended on new road construction, and this amount will be expended within the next eighteen months, if cars are made available. Many counties are contemplating the issuance of additional bonds for improved roads. The bonds, however, are not selling as well as they did a year ago. Separate road district bonds which, twelve months ago, were sold bearing interest at 5 per cent. per annum, are now being sold at 6 per cent., the public seeming willing to pay the high rate of interest in order to have the roads built promptly. In those counties where local surfacing material is available the work is not being delayed. The prospect for a good crop throughout the state has stimulated the demand for improved roads."

Oklahoma

T. F. Hensley, of the Oklahoma State Highway Department, comments on the road situation in that state as follows:

"The forecast for 1918, after the first depressing influence of our entry into the war has passed and our lost equilibrium, occasioned by the draft, is regained, seems to be reassuring. It would seem that the high cost of material will be offset by the unprecedented prices received for all kinds of farm products. It is apparent to all that a bushel of wheat or a measure

of any of the products of the soil will buy more bridge and road material than ever before in the history of the world. Then why should we pause in our road construction? is the question the producers of all wealth are asking. They see the necessity for good roads plainer now than ever before."

Large Federal Aid Projects in Oklahoma

The Ozark Trail was the first Oklahoma project to apply for federal and state aid. The promoters of this highway will soon construct a $150,000 bridge across the South Canadian river at New Castle.

The second project in point of magnitude now in sight is the construction of 40 miles of gravel road through McCurtain county on what is known as the "Broken Bow and Smithville highway."

The third project is the construction of five miles of asphalt macadam in McIntosh county, on the Jefferson highway—the king of all highways in Oklahoma.

The fourth project that will receive federal aid is another link of 18 miles in the Jefferson highway, in Ottawa county, the banner zinc producing county of the New Southwest. This stretch of 18 miles of this highway will be constructed either of concrete or asphalt macadam.

The fifth federal project is 5 miles of concrete or asphalt macadam in Oklahoma county, on the Ozark Trail, commencing at the Santa Fe railroad, on Twenty-third street, and extending east past the new Capitol building 5 miles into the country.

The sixth and last state and federal project in sight is a 6-mile stretch of concrete or asphalt macadam in Creek county, on the Ozark Trail, near Sapulpa.

County and Township Plans

In addition to the above state and federal projects, many counties and a few townships have voted large blocks of bonds and are now engaged, or soon will be, in surfacing dirt roads and in constructing permanent bridges and culverts of stone or concrete.

Foremost among these is Okmulgee county, which has issued and sold at a premium $800,000 in bonds, to be employed in general hard-surfaced road work.

Carter county has voted a $200,000 bond issue and has $68,000 of gross production oil tax to her credit, all of which will be used for general road betterment and in hard-surfacing dirt roads.

Hughes county has issued $600 a mile for the construction of 14 miles of mountain state roads. This road will be constructed of whatever material is found convenient and at hand. In order to piece out the bond issue and make it cover the work planned, the county commissioners have contracted with the State Board of Affairs for a prison camp of 100 men and 40 teams to do the work.

In Sequoyah county 9 townships have voted bonds ranging from $6,000 to $20,000 each, and County Engineer Wheeler says that every township in his county has given value received in permanent concrete and stone culverts and in well-surfaced and perfectly drained dirt roads.

The townships adjacent to Fort Smith, Ark., have built 30 miles of the finest dirt road to be found in the state. The city of Fort Smith, in order to show its appreciation of this work, and to gain the trade of this section of Oklahoma, is building a fine $500,000 concrete bridge across the Arkansas river. This bridge, which is a free bridge, is the gateway of the Albert Pike highway into the state of Arkansas.

Some Major Construction Projects of the Sanitary District of Chicago for 1918

President Charles H. Sergel of the Sanitary District of Chicago has given out a brief statement of the construction projects contemplated for this year.

The Calumet-Sag channel, which, when completed, will convey the sewage of the southern part of the city and the Calumet district away from the lake into which it now empties, to the main channel, will be completed during 1919, barring unforeseen delays. The Evanston sewers begun last spring probably will be finished by the end of 1918.

Pumping and Sewage Treatment Plants

With the completion of these projects the channel and sewer construction of the district practically will be ended. There still remain many pumping stations and other adjuncts of these works to be built. The trustees have had under consideration during the year plans for a pumping station in the Calumet district to pump sewage into the new channel, a pumping station in the Desplaines river district, and one at Evanston. Engineers are now working on plans for these structures and if finances of the district permit, construction work on them will be begun next year. In addition to these a sewage treatment plant to purify sewage before it enters the new channel is contemplated for the Calumet district.

A similar but smaller plant will be built in the Desplaines section. A site for the latter, containing twenty-seven acres, south of Twelfth street and west of the Desplaines river, has been bought and the trustees propose to begin work on the plant during 1918.

Bridge Work

Inability to get steel and high prices of materials of all kinds entering into bridge construction held up the district's bridge building program last year, and the same conditions likely will obtain during 1918. Bridges at California avenue, Crawford avenue, Cicero avenue, Harlem avenue, and Twelfth street are under consideration and will be built as soon as conditions will permit.

Activated Sludge Plant for Treating Stockyards Wastes

In addition to the work mentioned the district has been in negotiation with the stockyards interests concerning a plan to take care of the yards wastes and prevent them going into the main channel without treatment. These wastes are estimated as equivalent to the sewage of 1,000,000 people and place a heavy burden on the main channel.

The meetings with the representatives of the packers have resulted in a decision to build an activated sludge plant for the treatment of stockyards wastes. Negotiations for a site are under way and a proposal has been made to fill up Bubbly creek to form a portion of the site. It is estimated that the necessary plant for the packing house wastes will cost in the neighborhood of $4,000,000. It is proposed at first to build a unit plant that will treat one-thirty-second of the sewage, with one-fourth of all the sewage screened, at a cost of about $200,000. The question of the division of cost between the sanitary district and the packers has not been decided.

The principal requests of the engineering department for construction work during 1918 follow:

Evanston pumping station	$ 85,000
Desplaines river pumping station and treatment plant	140,000
Calumet pumping station	400,000
Ninety-fifth street pumping station	50,000
Desplaines river sewer	100,000
Evanston sewer	525,000
Calumet sewer	1,495,000
Calumet-Sag channel	1,124,000
Main channel improvement	500,000
Total	$4,419,000

Sheridan Road, Connecting Chicago and Milwaukee, to be Completed in 1918

By Ray Smith, President of the Sheridan Road Improvement Association of Wisconsin

There is every indication that the famous Sheridan road, connecting Milwaukee and Chicago, along the lake front, will be completed in 1918. This is based on the information received by the officials of the Sheridan Road Improvement association of Wisconsin, which has been in existence since 1915, to assist in bringing about the completion of the much-needed highway.

This road, when completed, will make it one of the famous highways in the country and will tend to stimulate business between the two big cities of the middle west, and open an avenue for travel that will bring thousands of tourists into Wisconsin, the "playgrounds of the west."

The following federal aid improvements on the Sheridan road are contemplated in Wisconsin for 1918:

Milwaukee County

Milwaukee county: The improvement by grading, draining, culverting and surfacing with concrete 18 ft. in width of a portion of the Milwaukee and Racine (Sheridan) road, commencing at the south federal construction limits in the city of South Milwaukee on the southwest quarter of section 11 T 5 N, R 22 E, and extending thence south about four-fifths of a mile to the north end of the present concrete road at about the center of section 14 T 5 N, R 22 E. The estimated cost of the proposed improvement is $18,000.

Racine County

Racine county: The improvement by grading, draining, culverting and surfacing with concrete 16 ft. in width of a portion of the Racine and Milwaukee (Sheridan) road beginning at the Milwaukee county line at the northwest quarter of section 1 T 4, R 22 E, and extending south about three and one-quarter miles to the north end of the existing concrete pavement in section 18. The estimated cost of the improvement is $51,000.

The improvement by the relocating, grading, draining, culverting and surfacing with concrete 16 ft. in width of a portion of the Racine and Kenosha (Sheridan) road, commencing at the south end of the present concrete in the southeast quarter of section 29, T 3 N, R 23 E, and extending thence about 1.2 miles to the south county line the south center of section 32, T 3 N, R 23 E. Estimated cost $24,000.

Kenosha County

Kenosha county: The improvement by the grading, draining, culverting and surfacing with concrete 16 ft. in width of a portion of the Kenosha and Chicago (Sheridan) road, commencing at the south end of the concrete road contracted to be built in 1918, and extending about one and one-half miles to the state line. Estimated cost of this project is $26,000.

The cost of all these projects will be borne: One-third by the federal government, one-third by the state and one-third by the county in which the construction lies.

Cook and Lake Counties

For the Illinois side, Cook county voted a $1,000,000 bond issue for the roads. Lake county recently voted a bond issue of $500,000 and the county clerk of that county states that this will be utilized this year to build a road which starts at the highway running northward to the Lake county line in Cook county and runs easterly into Waukesha, and thence northward over to the Sheridan road to the Wisconsin state line, completing the road in Illinois.

Sanitary District of Chicago Offers Federal Government $475,000 to Build Controlling Works to End Lake Levels Controversy

Fear that the United States government may succeed in its efforts to force the Sanitary District of Chicago to reduce the amount of water taken from Lake Michigan for the drainage canal (which handles the sewage of Chicago) has caused the trustees of the District to make an offer to the federal government which it is hoped, and expected, will do away with the diversion and lake levels controversy which has hung over the sanitary district for years.

At a meeting of the trustees of the district on January 5, an ordinance was adopted which binds the district to pay the United States $475,000 and such additional money as may be necessary to construct submerged weirs in the St. Clair and Niagara rivers for the purpose of reducing the flow of water from Lakes Erie, Michigan and Huron. Such weirs, it is estimated by government engineers, would in a few years bring the level of the water in the Great Lakes up to what navigation interests maintain it should be.

Injunction Case Brought

The government has brought injunction proceedings against the sanitary district to restrict the amount of water allowed to flow through the canal and a decision is expected at any time, the cases having been tried before Judge Landis several years ago. If the decision is adverse to the contention of the sanitary district that it has the right to draw 520,000 cu. ft. of water a minute from Lake Michigan the situation would be extremely serious, if not dangerous. The government contends that only 250,000 cu. ft. a minute should be drawn. Limited to that amount only, the sanitary district would have to construct supplemental works for disposing of Chicago's sewage.

The present proposal of the sanitary district is to follow the recommendations of a special board of engineers appointed by the secretary of war in 1910. There is no trouble about Lake Ontario, the Canadian government having closed the Gut channel of the Galops rapids, which has raised the level of the lake to an amount nearly equal to the computed lowering of the lake by the diversion of water at Chicago.

To Build Three Great Submerged Weirs

To compensate for the loss of water in Lake Erie, it is proposed to construct three submerged weirs in Niagara river in the vicinity of Squaw Island, which would average about 4.2 ft. in height and would contain about 15,000 cu. yds. of masonry. The estimated cost is $150,000.

To raise the levels of Lakes Michigan and Huron submerged weirs would be constructed in St. Clair river covering three miles of river below the mouth of Block river, at Port Huron. The weirs would have a height of from 5 to 6 ft. above the river bed, and contain about 65,000 cu. yds. of material, the estimated cost being $325,000. It is computed that these weirs will increase the velocity of the water only slightly. On the other hand, above the mouth of the Black river the river slopes, and velocities which are now excessive will be diminished, and it is asserted navigation would be considerably benefited.

The engineers reported that the Chicago diversion of water had no effect on Lake Superior.

Attorney Gives an Opinion

E. D. Adcock, attorney for the sanitary district, has given the trustees an opinion that the ordinance passed meets all recommendations made by the federal engineers, and will settle a controversy that might result disastrously for Chicago. In his conclusions Mr. Adcock says:

"In view of all the facts and circumstances, it would seem that the payment of the comparatively small sum of $475,000 to settle this whole controversy and relieve the dis-

trict from the possibility of its being curtailed in the amount of water withdrawn is reasonable, and is the only proper and wise course to pursue if the United States will agree."

Having passed the ordinance, the next move of the sanitary district trustees will be to interest the Cook county delegation in congress and have the matter brought before the war department in a regular way. It is not proposed that the district shall construct the weirs, the proposal being that the money be paid to the secretary of war or any designated official, the government to put in the masonry.

A Definite Legislative Policy to Develop the Nation's Water Power

Early in January President Wilson laid before a conference of house leaders the draft of a bill designed to establish a definite legislative policy to develop the nation's water power, 35,000,000 horse power of which is estimated by government engineers to be wasted annually. The conferees adopted a plan to create a special committee of the house to take over all jurisdiction of water power problems and to pass the president's bill promptly.

The new measure was drawn by the interior, war, and agricultural departments. It follows closely the provisions of the Ferris bill, which has twice passed the house, but failed in the senate.

Provides for Long Lease

The bill provides for a commission to be composed of the secretaries of war, interior, and agriculture. It proposes to lease the water power privileges on public lands, Indian lands, national forests, and in navigable streams for not exceeding fifty years, when the project may be taken over by the United States, again leased to the original lessee, or leased to a new lessee.

All property owned and held by the licensee at the expiration of the lease, valuable and serviceable in the development or distribution of power, together with any locks or other aids to navigation constructed by the lessee, may be taken over by the government upon the payment of the fair value, not to exceed the actual cost of the property taken, plus such reasonable damages as may be caused by the separation of the property from valuable property not taken.

Where Money Will Go

Fifty per cent. of the proceeds from national forests shall be expended in construction of roads in those forests; 50 per cent. of the receipts from public lands are to be placed in the reclamation fund; 50 per cent. of the receipts from navigable streams are to be expended in the maintenance and operation of dams and other navigation structures of the United States, and all proceeds from Indian reservation shall be placed to the credit of the Indians.

The president asked that the house rules committee report to the house a rule creating a special committee on water power, with a view to supplying its membership from the regular committees now claiming jurisdiction. It was then suggested the committee be created by a special rule, each of the regular committee members to be taken from their personnel and the speaker appointing them on the new body. This plan was virtually agreed upon.

PERSONAL ITEMS

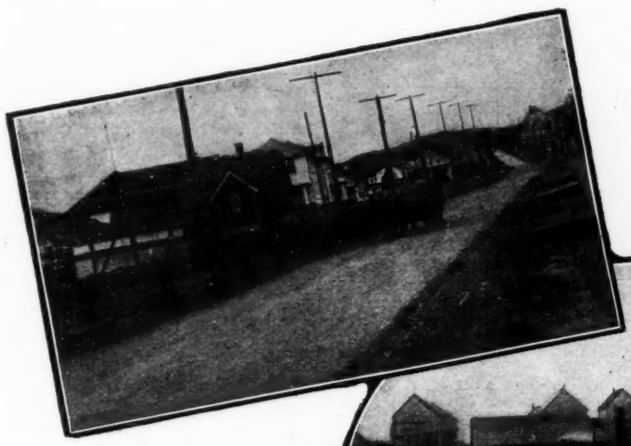
A. LINCOLN GOLINKIN is now engineer inspector of construction with the Milwaukee Sewerage Commission. He is a graduate of the University of Illinois, class of 1917, and has the degree of B. S. in Municipal and Sanitary Engineering. He was formerly field engineer, commercial department, Chicago Telephone Co.

JOHN HAYES SMITH, consulting engineer of Milwaukee, has closed his office to accept a position as assistant engineer to the Public Service Commission of Pennsylvania. Mr. Smith is a graduate of Cornell University who associated himself with the Westinghouse Electric & Manufacturing Company shortly after graduation, remaining in their employ about six years. He is best known as the first manager of the Electric Journal, Pittsburgh. Resigning this position, he became editor of the Electrical Age, New York, for four years. Since that time Mr. Smith has been in Milwaukee. For two years he was with the Milwaukee Electric Railway & Light Company, resigning as commercial engineer to take up consulting work. For the last four years he has been actively identified with much important work in Milwaukee, as well as engaged in rate and valuation work in other states.

H. R. CAMPBELL, on January 1, resigned his position as statistician of the Pennsylvania State Highway Department, because of ill health. He came from Washington, Pa., and was appointed statistician on April 2, 1917, by F. B. Black, former state highway commissioner, to fill the vacancy caused by the resignation of W. R. D. Hall. For a number of years Mr. Campbell was connected with the county commissioners' office, at Washington, Pennsylvania.

WILLIAM D. UHLER, chief engineer of the Pennsylvania State Highway Department, has been commissioned a major in the Ordnance Reserve of the United States Army. As provided for in the act approved June 7, 1917, Mr. Uhler has requested leave of absence from his duties, which request has been granted by Governor Martin G. Braumbaugh. It is Mr. Uhler's intention, as far as possible, to keep in touch with the work of the State Highway Department. He is considered one of the best road engineers in the United States, was appointed chief engineer of the Pennsylvania State Highway Department on April 7, 1915, to fill the vacancy caused by the resignation of Samuel D. Foster. He was born in Nazareth, Pennsylvania, Nov. 8, 1872. From 1890 to 1895 he was connected with the engineering department of the Lehigh Valley Railroad, leaving there to enter the employ of the Queen Ann's Railroad, where he remained for eight years in various capacities from assistant engineer to general manager and chief engineer. In 1904 Mr. Uhler became county roads engineer of Caroline county, Maryland, serving four years, after which he was appointed to be engineer in charge of maintenance of the Maryland State Roads Commission. He resigned this position in 1912 to become principal assistant engineer of the Bureau of Highways in the city of Philadelphia. It was while serving in this capacity that he was selected by Governor Brumbaugh to become chief engineer of the State Highway Department. Mr. Uhler is a member of the American Society of Civil Engineers, the American Road Builders' Association, the Engineers' Club of Philadelphia, the Engineers' Club of Baltimore, the Engineers' Society of Harrisburg, the American Society for Testing Materials, the American Society of Municipal Improvements and the American Concrete Institute. At its recent meeting in Richmond, Virginia, Mr. Uhler was elected president of the American Association of State Highway Officials.

ARTHUR GROESBECK, for the past 3½ years superintendent of the water and electric department of McPherson, Kans., has resigned that position and accepted a position with The Riverside Light & Power Co. of Abilene, Kans., as efficiency engineer of the different generating stations. He is a graduate of the University of Kansas, class of 1909. He was formerly chief engineer, Cordova Power Co., Cordova, Alaska, and later superintendent of the water and light department at Stafford, Kans. He assumed his duties at Abilene on January 1.



One of the many streets in Coppercliff, Ontario, treated with "Tarvia-B," 1917.

Sudbury-Coppercliff Road, Ontario, three and a half miles long. Resurfaced in 1916 with three-inch "Tarvia-X" top, three-coat method.

Applying "Tarvia-X." Sudbury-Coppercliff Road, Ontario, 1917.

Frost-proof Roads in the "Frozen North"

Winter temperatures in the Algoma district in northern Ontario are so severe that few road-making materials can withstand them.

Tarvia does!

Under the severest tests, Tarvia has proved itself frost-proof, mud-proof and traffic-proof, regardless of long-continued zero weather or other equally rigorous climatic conditions.

The Sudbury-Coppercliff Road pictured above is three and a half miles long. It carries a very heavy wagon-traffic. It has a three-inch Tarvia surface, making it impervious to the wear of traffic, the effects of the severe northern winter, and to the equally trying spring thaw when ordinary roads soon become impassable.

Tarvia is a coal-tar preparation shipped in barrels or in tank-cars.

Tarvia
Preserves Roads
Prevents Dust

It is made in several grades for varying road conditions.

"Tarvia-A" is applied hot for resurfacing a road already built.

"Tarvia-B" is used cold. It sinks readily into the road-surface, yet is strong enough to bind it firmly together. It is the cheapest form of road maintenance yet invented.

"Tarvia-X" is to be used in constructing a new road.

Macadam roads treated with Tarvia are durable, smooth, mudless, dustless, frost-proof and water-proof.

Used in place of water as a binder, it makes a lasting, resilient road-surface that will not grind to powder under automobile or horse-drawn traffic.

Booklets describing the Tarvia treatments free upon request.

Special Service Department.

This company has a corps of trained engineers and chemists who have given years of study to modern road problems.

The advice of these men may be had for the asking by any one interested.

If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention.

The Barrett Company

New York Chicago Philadelphia Boston St. Louis Cleveland Cincinnati Pittsburgh
Detroit Birmingham Kansas City Minneapolis Nashville Salt Lake City Seattle Peoria

THE BARRETT COMPANY, LIMITED: Montreal Toronto Winnipeg Vancouver
St. John, N. B. Halifax, N. S. Sydney, N. S.

TRADE B MARK

CONTRACT NEWS

CONTRACTS AWARDED

ROADS AND STREETS.

Ala., Geneva—Crawley & Co., Bank, award. contr. for bldg. portion of Samson & Opp Rd., at $17,757.

Ark., Little Rock—W. E. Wilcox Contract'g Co., Gans. City, Mo., award. contr. for paving 2 miles E. 6th St., at $75,000.

Ariz., Phoenix—Southwestern Contract'g Co., City, award. contract for curb'g, gutter'g, bithu. pav'g, etc., on 3rd & Wetmoreland Aves., at $11,000 & $15,000 respectively; also for grading & construct'g bithu. pavement on Willetta St., 3rd to 5th Aves. 2,036 sq. yds. at $2 sq. yd.

Ariz., Yuma.—O. & C. Constr. Co., Yuma, award. contr. for improv. of several streets, at $58,077.

Cal., Calexico—G. R. Daley, McNeece Bldg., San Diego, award. contr. for improving main streets with bithu., 5-in. conc. base and 2-in. top; also other streets with Warrenite, at $174,322.

Cal., Fresno—C. M. Baker, City, award. contr. for construct'g 3 detours on old Millwood Rd., around Squaw Valley, Boren & Irwin Hills, at $9,200.

Cal., Los Angeles—M. S. Cummings, 1802 W. 22nd St., City, award. contr. for grading, conc. curbs & gutters, conc. paving, moiling, etc., Lemoyne St., at $8,478.

Cal., Los Angeles — Fairchild-Gilmore-Wilton Co., award. contr. for grad'g and paving 10th St., betw. east & west lines Palos Verdes St.

Cal., Los Angeles—W. R. Hailey, City, award. contr. for improving portion of First St., at $14,274.

Cal., Madera—Hugh Crummey, Oakland, award. contr. for paving F St., and Yosemite Ave., at $83,918.

Cal., Riverside—Gill & Riley, Thermal, award. contr. for grading & paving por-8 mi. betw. Willits & Arnold, at $112,931. Healy-Tibbitts Constr. Co., San Francisco, award. contr. for constr. of river rd. on Grande Isl., 13.25 mi. conc., at $137,300.

Cal., Sacramento—Geo. S. Benson & Sons, Los Angeles, award. contr. for construct'g 11 mi. hwy., Monterey Co., at $104,773.

Cal., Sacramento—Duncan-Harrelson Co. San Francisco, award. contr. for bldg. rd. Marin Co., at $32,689.

Cal., San Francisco—H. Crummey, Inc., Hearst Bldg., City, award. contr. for bldg. portion Hunter's Point Rd., at $17,282.

Cal., Stockton—C. Moreing & Sons, City, award. contr. for bldg. highway near Tracey, at $13,260.

D. C., Washington—Geo. B. Mullins Co., Geo. Hyman & Edw. G. Gummell, City, award. contract for approx. 31,300 cu. yds. grading, at $8,700, $8,000 and $6,000 respectively.

Fla., Deland—Ackerman & Ellis, Titusville, award. contr. for grading, drain'g & pav'g 15.9 mi. macad. rd., at $96,356.

Fla., Perry—Edwards Constr, Co., Judy Dock, Tampa, award. contr. for asph. pavement on macad., at $75,000.

Ill., Kankakee—F. L. Shidler, Kankakee, award. contr. for paving 9 blks., Chicago Ave. (brk. bldg.) at $60,247.

Ill., Rockford—F. R. Carice, 1109 Kilburn Ave., City, award. contr. for paving Churchill St., at $11,000.

Ind., Anderson—Ind. Asphalt Pav. Co., award. contr. for paving on Meridian Ave., at abt. $60,000.

Ind., Angola—A. B. Goodrich, Ashley, award. contr. for grading & graveling 6 mi. of rd., Jamestown Twp., at $16,000.

Ind., Corydon—Merryman & Ferguson, Milltown, award. contr. for construc. of 14,543 stone rd., Spencer Twp., Harrison Co., at $10,500.

Ind., Elkhart — Northern Constr. Co., City, award. contr. for paving, curbing & improv'g W. Lexington & Mich. Sts., at $39,225.

Ind., Jeffersonville—Thos. F. O'Neil, City, award. contr. for constr'g 13,242-ft. rd., Jeffersonville Typ., at $20,000.

Ind., Knox—Frank J. King, La Porte, award. contr. for paving, grading and construct'g curb on Lake, Shield and Delaware Sts., at $16,792.

Ind., Kendallville—A. Moellering, Ft. Wayne, award. contr. for paving several streets, at $45,500.

Ind., Lafayette—Wm. Mahoney & S. S. Palma, award. contracts for 2 gravel rds., Tippecanoe Co., at $6,800 and $7,990, respectively.

Ind., Portland—Walter Swisher, City, award. contr. for construc'g stone rd., Jefferson Twp., at $17,000.

Ind., Shelbyville — J. Harvey Snider, Fountaintown, Ind., award. contr. for gravel rd., Marion & Brandywine Twps., at $1,225. Sexton & Bolts, City, award. contr. for construct'g gravel rd., Washington Twp., at $9,596.

Kans., Augusta—Besler Constr. Co., Winfield, award. contr. for paving Augusta St., at $34,000.

Kans., Kans. City—Readsoker & Bouseman, Rosedale, award. contr. for repaving 5.5 mi. Kaw Valley Rd., at $23,500.

La., Shreveport—Kennedy-Olson Constr. Co., Kans. City, Mo., award. contr. for paving Olive St., at $60,000.

Mass., Boston—Jno. McCourt, City, award. contr. for walks on Boston Common, at $16,763.

Mass., Boston—Central Constr. Co., City, award. contr. for grading in Grove St., W. Roxbury, at $33,260.

Mass., Boston — Warren Bros., local, award. contr. for paving Fens Pkway., at $17,207.

Mass., Dorchester—J. A. Sullivan, 35 Melville Ave., award. contr. for grading Saving Hill Playground, at $45,291.

Mich., Wyandotte—J. H. Baker & Son, Port Huron, award. contr. for paving 6 streets, at $150,000.

Mich., Wyandotte—J. H. Baker Co., 1454 Penobscot Bldg., Detroit, award. contr. for paving Spruce, Cherry, Cedar, Orchard, Forest & Plum Sts., at $13,000.

Minn., Hibbing—Malloy Bros., City, award. contr. for paving Du Pont & Dublin Rds., at $32,627.

Mo., Jefferson City—Pope Constr. Co. & L. Brunnor, Jefferson City, award. contracts for improv'g portions Henry & Marys Home Rd., Hough Pk. Drive, Osage Bend & Williams Ferry Rds., Russellville-Centerton Rd., Boonville & Decatur Rds., at $17,563.

Mo., Kansas City—H. Rittenger, City, award. contr. for paving Agnes Ave., Missouri Stone Wks. Constr. Co., contr. for paving on Illinois Ave.

Mo., Stanberry—Edgar Main, Liberty, Mo., award. contr. for paving 5 blks. Main St., with brk., asph. filler, at $20,000.

Neb., Columbus—W. Harrahan, 1422 Walnut St., Iowa City, Ia., award. contract for 29,528 sq. yds. bithu. pav'g, at $2.36 sq. yd.

Neb., Holdredge—Roberts Constr. Co., 510 1st Natl. Bk. Bldg., Lincoln, award. contr. for improv'g streets Dist. No. 1, at $2.54 sq. yd., 30,100 sq. yds. pav'g, 10,053 lin. ft. curb & gutter.

N. J., Cape May—Cassidy & Homan, City, award. contr. for bldg. rd., Cold Spring Harbor to Wildwood Crest, at $84,879.

N. J., Newark—Newark Paving Co., 133 1st St., award. contr. for improving San-

KOLESCH SURVEYING INSTRUMENTS FOR SERVICE

Municipal Engineers!

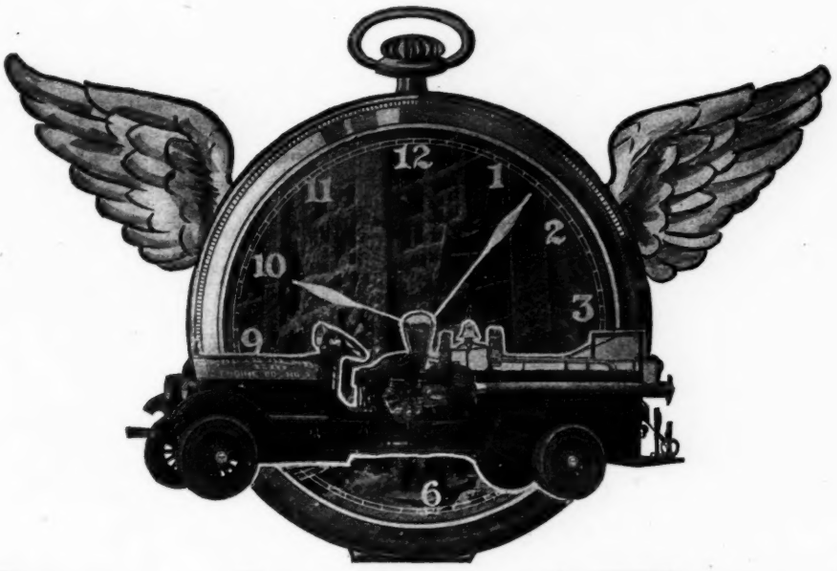
We will gladly send you one of our instruments to test on your work without any obligation to purchase until it has proved its worth. **Kolesch Transits and Levels** are sturdy, accurate and moderate in price. Every detail has been studied to give an instrument that can be absolutely depended on for unvarying reliability and long life.

Send today for Catalog illustrating full line of Engineers' and Draftmen's supplies.

KOLESCH & COMPANY

138 FULTON STREET NEW YORK CITY

The Popular Kolesch "PIONEER" TRANSIT No. 7710.



Goes to Beat Time!

"THE *Best Built* Fire Fighting Apparatus in America"—that's how a Leading Fire Chief defines South Bend "Double Duty." "Each and *every* piece is built (by Experts) to fill the Individual Requirements of the Chief ordering it. Each and Every unit is a *Tested* Fire-Fighter—and the hard-learned lessons of *Actual* fire-fighting are built into it."

The pealing of Silver-Tongued Bells and the loud shriek of fire whistles are passing away.

THE telephone lets loose an electric spark which opens the doors for South Bend "Double Duty"—without a second's delay, You're off Like A Flash. Miles are reckond in Minutes. From a standing leap straight into it—From nothing to Sixty Miles An Hour, South Bend "Double Duty" gets you there on the ***Double Quick!*** You're riding on High Speed—High Efficiency Apparatus—you're getting not only greater power, but truly Wonderful Smoothness and Sprightliness.

The reason goes back to "Double Duty" Quality and Sound "Double Duty" Engineering principles accompanied by the *Utmost* Care and *Skill* in the shops; to Nicety of fit and *Exact* co-ordination of all parts.

With us the building of Better fire-apparatus is a *Science*—Our Life Work! Its *all* we do—and we're doing it better than it was ever done before. If this concentration of effort did not result in Better Motor Fire Apparatus for You we would do something else.

Eastern Representative:
WALTER M. HELLER, 142 Market St., Newark, N. J.

SOUTH BEND MOTOR CAR WORKS
SOUTH BEND, IND.

ford Ave., Irvington-Newark line to Newark-E. Orange lien, at $119,800.

N. Y., New York—Cleveland Trinidad Paving Co., Flushing, award. contr. for widening, regulating & repairing with wood blk. on conc., rdway of Madison Ave., also regulating & repaving with sheet asph. rdway of 52nd St., at $13,001.

N. Y., New York—Oscar Daniels Co., 233 Broadway, award. contr. for grading and paving with sheet asph. & granite blk., at $234,984.

N. C., Clinton—R. M. Hudson, Empire Bldg., Atlanta, award. contract for asphalt paving, at $50,000.

O., Akron—E. & W. McShaffery, 269 W. Chestnut St., award. contr. for grading, paving & sewering on Grant St., at $23,692.

O., Canton—F. A. Downs Constr. Co., award. contr. by Stark Co., for bldg. Minerva-Robertsville Rd., Lawrence Rd., & Gibbs Ave., at $48,782. E. Vogt, Massillon, award. contr. for bldg. Brewster-Massillon Rd., at $21,784. H. Cork, Canton, award. contr. for Navarre-Richville Rd., at $45,033.

O., Cincinnati—Henkel & Sullivan, award. contr. for construct. of Bloody Run Pkway., Park Ave. Brdg. to Cypress Ave., at $64,-705; 27,000 yds. grading; sheet asph. surfacing.

O., Galion—L. R. McMichael, Bucyrus, award. contr. for paving Lincoln Hwy., Renschville to Beck's, and west of this city, at $56,000.

O., Maumee—Warner-McKetchie Co., Nasby Bldg., Toledo, award. contr. for conc. paving on several streets, at $17,000.

O., Newark—Purdue & Schwartz, Newark, award. contr. for grading & macadamizing, at $31,576.

O., Van Wert—Putnam & Shingledecker, City, award. contr. for construc. of 4.3 miles waterbound macad. rd. on Lincoln Hwy., at $50,070.

O., Youngstown—Kelley & Mayer Co., award. contr. for paving Hilton, Revenwood & Auburndale Sts., at $57,794.

Ore., Pendleton—Warren Constr. Co., Journal Bldg., Portland, award. contract for paving Lewis St., Lee to Beauregard, and Wilson, Madison to Main St., at $10,000.

Ore., Portland—United Contg. Co., N. Western Bk. Bldg., City, award. contract for grading on Ochoo-Forest Rd., 1½ mi., at $25,070.

Okla., Ardmore—Ardmore Constr. Co., City, award. contr. for paving 3rd Ave. with asph., H to L Sts., at $15,359.

Okla., Okmulgee—Western Paving Co., Okla. City, award. contr. for Warrenite rd., at $2.28 per sq. yd. Work will be done under patents & expert lab. supervision of Warren Bros. Co., Boston. Est. cost $300,-000. Harrison Construction Co., Henryetta, award. contr. for the grade & drainage at approx. $170,000.

Okla., Okla. City—Western Paving Co., City, award. contr. for paving 13th St., at $12,510.

Okla., Sapulpa—J. E. Noland, City, award. contr. for paving Bryan & Thompson Aves., at $12,282.

Pa., Allentown—Geo. H. Hardner, award. contr. for construct'g rdway. on State brdg. across Lehigh River, at $38,342.

Pa., Harrisburg—J. E. Richey, J. W. Cramer & McK. Snow, Franklin, award. contr. for construct'g vit. blk. pavement, 7,857 ft., Oil City to Rouseville, at $52.888.

S. C., Spartanburg—Morrison & Glover, Augusta, Ga., award. contr. for surfacing conc. rd. to Camp Wadsworth, at $37,000.

Tenn., Greenville—Mann Constr. Co., Greenville, award. contr. for grading 175 mi. earth rds., & macadamizing 147 mi., at abt. $510,000.

Tex., Dallas—S. M. Haley, City, award. contr. for construc. of culvert on Victor St., Carroll Ave. to Prairie, at $15,644.

Tex., Houston—H. K. McCollum, City, award. contr. by Harris Co. Comrs., for constr. of Webster Airline Rd., Houston to Galveston Co. line, at $90,630.

Tex., Wheeler—Smith Bros., Crockett, Tex., award. contr. for constructg. rds. Wheeler Co., at $35,000.

Wash., Everett—Howard S. Wright, City, award. contr. for construc. of permanent hwy. No. 32, at $28,448.

Wash., Olympia—L. H. Goorig, Seattle, award. contr. for constr'g. 5 mi. Pac. Hwy., Woodland to Martin's Bluff, at $80,007.

Wash., Pasco—Porter & Conley, Portland, award. contr. for construct'g Pasco & Rattlesnake Flat Rd. Exten. No. 1, at $28,845.

SEWERAGE AND SEWAGE TREATMENT.

Ala., Sheffield—Westinghouse, Church-Kerr & Co., 37 Wall St., N. Y. City, award. contr. by Air Nitrates Corp. (controlled by Government), for sewer construction. This is in connect. with bldg. homes for employes of ammonium nitrate plant to be built by Government near Mussel Shoals, at $30,000,000.

Ariz., Yuma—C. H. Julian, San Diego, award. contr. for constr. of san. sewers, Distr. No. 3, at $43,339.

Cal., Daly City—H. Crummey, Hearst Bldg., San Francisco, award. contr. for lay'g sewers & construct'g conc. walks; also asph.-conc. pavements, at $19,800.

Cal., Fresno—Frederickson & Shannon, award. contr. for construct'g conc. septic tank at sewer farm, $22,112.

Cal., Long Beach—Johnson-Shea Co., P. O. Box 906, Riverside, award. contr. for construct'g vitr. pipe san. sewer in 11th St., Poinsetta Ave., Vine St., Mahanna, Esperanza, Gardena, Orange, Cherry & other streets, at $67,750.

Cal., Los Angeles—Johnston & Grohs, local, award. contr. for constructing storm drain & appurt., in Ocean View Ave., Bonnie Brae 7 others, at $3,222.

Cal., Los Angeles—Mlagenovich & Gillespie, 3929 Wash. St., Los Angeles, award. contr. for constr. of drainage sys., Dist. No. 2, includ'g lowland near W. Adams St., at $130,282 for underground drainage; $12,-700 surface drainage systems.

Cal., Martinez—Lindgren & Co., Monadnock Bldg., Los Angeles, award. contract by Bay Point Utilities Co., for bldg. large reservoir, new water mains & modern sewerage system.

Cal., San Diego—Holland Constr. Co., Granger Bldg., City, award. contr. for constr. of rein.-conc. storm-drain, Logan Ave. & 16th St., at $24,470.

Ga., La Grange—W. H. Goodloe, Amer. Natl. Bank Bldg., Macon, award. contr. by International Cotton Mills Co., for install'g storm sewers in La Grange & Hogansville, at abt. $20,000.

Ill., Normal—Foley Constr. Co., 127 N.

Oil Burning Steam Locomotives

"Our 5-ton Bell Locomotive," states the Newman & Carey Subway Construction Co., Brooklyn, "daily hauls 500 tons a distance of 12½ miles on a fuel oil consumption of but 18 gallons.

"And it has been hauling *continuously* for six months. Repair bills are unusually low. It is of Stronger construction through and through with More and Better metal at every point of strain."

Bell Locomotives use the cheapest fuel—kerosene fuel oil, distilate or crude oil. Their low center of gravity permits of High Speed over Rough Tracks. And they are right in price.

Sizes: 2 to 18 tons. Prices, Specifications and illustrated particulars on request. Some open territories for live salesmen.

You'll find our Bulletin Interesting.

BELL LOCOMOTIVE WORKS, Inc.

30 Church Street. (Founded 1908) **NEW YORK CITY.**

An "Armco Iron Culvert being placed under the California" State Highway near Fresno, California.

When War makes Labor Scarce

it is a satisfaction to know that unskilled men can install

"ARMCO" IRON CORRUGATED CULVERTS

quickly and efficiently. They are shipped without delay, hauled easily and placed quickly, and will last a generation.

Their unfailing durability is their chief recommendation. They are made of "Armco" Iron—the purest and most rust-resisting iron that can be used.

AMERICAN ARMCO INGOT IRON

Resists Rust

For full information on Rust-Resisting "Armco" Iron Culverts, Flumes, Siphons, Sheets, Roofing and Formed Products, write

Armco Iron Culvert & Flume Mfrs. Association

CINCINNATI, OHIO.

CONCRETE FOR PERMANENCE

A Greenwich, Conn., road built of Atlas Portland Cement Concrete

Concrete Roads—a good investment

A highway ought to outlast the bonds that pay for it. Upkeep ought to be small.

A Portland cement concrete highway costs little more to build than a non-permanent road—much less for maintenance.

The non-permanent type frequently needs rebuilding before the 15-year bonds for it are paid. Concrete should be in good condition long after the bonds have matured.

Get our free book on "Concrete Highway Construction."

The Atlas Portland Cement Co.

Member of the Portland Cement Association

New York Chicago Philadelphia Boston St. Louis
Minneapolis Des Moines Dayton Savannah

PORTLAND ATLAS CEMENT

"The Standard by which all other makes are measured"

ANNOUNCEMENT

On and after February 1, 1819, our general offices will be located at 7323 Woodlawn Ave., Chicago, Illinois, and we respectfully request all our friends and customers to address all communications to the Company at our new location after that date.

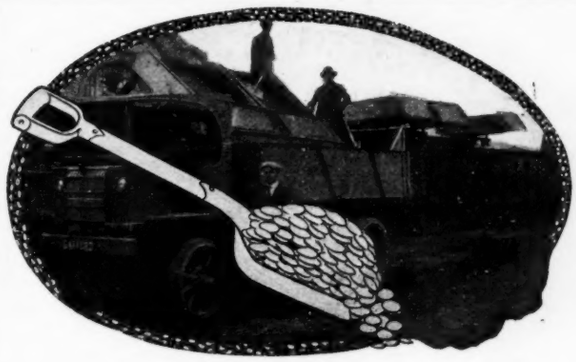
We shall continue to produce a full line of bituminous products of the highest quality, and asphalts for every purpose, and whenever you are in the market for paints, pipe coatings, expansion joint, mineral rubber, insulation compound, filler, road asphalt, roofing cement, waterproofing, or any other bituminous products of similar nature, kindly give us an opportunity of figuring with you on your requirements.

Our Policy—"A Personal Interest in Every Order; an Earnest Endeavor to Please."

The Pioneer Asphalt Co.

Producers of Highest Quality Bituminous Products.

Chicago, Ill. **Lawrenceville, Ill.**



Idle Shovels Cost Money

Uncle Sam wants you to ***speed up*** unloading. And you're not anxious to pay that demurrage charge which has been increased to $10 per day! Therefore ***quick*** unloading is essential.

The **Heltzel "Lightning" Loader Skip** keeps all your shovelers busy ***all*** the time. That means fewer shovelers—fewer trucks. No "loafing" of men in the car and no "stalling" of drivers on the trucks. Do you want to put more "shove" into your shovelers and more "go" into your trucks? Do you want to sidestep demurrage? Do you want to save $6.00 per car in unloading costs? Then write for illustrated particulars!

The Heltzel Steel Form & Iron Co.

WARREN, OHIO.

Dearborn St., Chicago, award. contract for bldg. West Side Sewer, at $16,715.

Ind., Frankfort—C. A. Donho & Son, Frankfort, award. contr. for bldg. St. sewer W. Washington St., at $13,137.

Ind., Hammond — United Constr. Co., award. contr. for construct'g sewer in Atchison Ave., at $96,000.

Ind., Indianapolis—Columbia Constr. Co., City, award. contr. by city for bldg. sewer E. 30th St., Hillside Ave. & School St., at $93,687.

Ind., Lafayette—Foley Constr. Co., St. Louis, award. contr. for sewer construc. at Normal, Ill., at $16,715.

Ind., Mich. City—Jas. Gamble, Gary, award. contr. for sewer construc. in Canada Ave., at $53,000.

Ind., Union City—J. L. Teegarden, Union City, award. contr. for bldg. 7,000 lin. ft. various sized pipe sewer on Plum St., at $18,490.

Ia., Sioux City—F. T. Leeder, award. contr. for construct'g Riverside sewer pumping sta., at $10,900.

Kans., Augusta—McCoy & Taylor, Wichita, award. contr. for bldg. storm sewer, at $16,000.

Mass., Boston—M. De Disto, City, award. contr. for sewer construction in several alleys, at $3,022; also contr. for sewer construc. in Elder St., at $2,480. Timothy Coughlin, City, contr. for sewers in Stanwood St., at $1,219.

Mass., Brockton—Power Equip. Co., 131 State St., Boston, award. contr. for new elec. equip. for Campello sewerage pump'g sta., at $12,750.

Mich., Detroit—Jeynes & Affeld, City, award. contr. for construct'g Linwood Ave. public sewer, at $279,453. Wm. Blanck Co., City, award. contr. for construct. of Davison Ave. arm, at $26,370. John A. Mercier, City, award. the contr. for construct'g Third St. sewer, at $302,300.

Mich., Detroit—Thompson-Robinson Co., award. contr. by Bd. of Public Wks. for lateral sewer No. 2976, at $482; No. 2977, $1,085; No. 2933, $82; Wolverine Engr'g & Constr. Co., local, contr. for lateral sewer No. 2981, at $5,500; 2892, $5,139; 2983, $4,720; 2984, at $4,470.

Mich., Detroit,— Moreno-Burkham Co., award. contr. for sewer construc. in Buena Vista Ave., at $7,419.

Mich., Saginaw—Wm. Eddy & Sons, award. contr. for construct'g sewers, at $5,180.

Minn., St. Paul—O'Neil & Preston, City, award. contr. for bldg. Otto-Niles sewerage sys., at $90,600.

Mo., Kans City—Chas. H. Cosby, 12 E. 9th St., City, award. contr. for furnish'g matl. & construct'g distr. sewers in Distr. No. 409, at $49,526.

Mont., Terry—Security Brdg. Co., Billings, award. contr. for san. sewer sys., at $3,958.

N. J., Cedar Grove—Sanitary Sewage Corp., New York City, award, contr. for install'g patented electrolytic sewage disp. plant for Overbrook Hosp., at $52,500.

N. J., Manasquan—Sincerbeaux & Moore, 1st National Bk. Bldg., Princeton, award. contr. for bldg. addns. to sewerage sys., at $10,000.

N. Y., New York—Reilly Contg. Co., 202 E. 90th St., award. contr. for rebldg. sewer in 63rd St., at $16,1-86. J. Pilkington Co., 1st Ave. & 96th St., award. contr. for bldg. san. sewers & pumping sta. & appurtenances in Thompson St., at $211,787.

N. Y., Rochester—F. V. Brotsch Co., E & B Bldg., City, award. contr. for sewer construc. & bldg. walks on Grand Ave., at $25,335.

N. Y., Syracuse—Mondo Constr. Co., City, award. contr. to bld. 21-in. pipe sewer in Glenwood Ave., at $2,190; 12-in. pipe sewer in Spencer St. Gedder St. & the Blvd., at $3,911.

O., Cleveland—Gawne Constr. Co., local, award. contr. for construct'g sewers in Corlett Ave., at $46,000.

O., Columbus—W. D. Sullivan, City, award. contr. for construct. of sewer in Markison Ave., at $2,452. H. F. Ryerson, City, award. contr. for sewers in various alleys, at $8,600.

O., Cuyahoga Falls—C. L. Wright, Mt. Vernon, award. contr. for san. sewer construc., at $17,000.

O., Ravenna—F. George Co., Jenkins Arcade, Pittsburgh, award. contr. for bldg. gravity conduit line, at $41,000.

Ohio, Youngstown—Turner Constr. Co., award. contr. for construct'g Sec. 1 Mill Crk. Distr. Sewer, at $131,108; F. George, contr. for Sec. 2, at $103,445; Edw. Conricote, Sec. 3, at $80,084; A. P. O'Horo Co., Sec. 4, at $76,690.

Okla., Tulsa—C. Pleasant, Iowa Bldg., City, award. contr. for laying 7,200 ft. 24-in. c. i. pipe, at $14,995.

Pa., Philadelphia—J. J. McHugh, 1430 S. Penn Sq., City, award. contr. for bldg. intercept'g sewers along Frankford Crk.; also miscel. piping for grit chamber north of Lycoming St. and west of O St., at $37,000. E. C. Fish Co., Real Est. Trust Bldg., City, award. contr. for lay'g water pipes in Parkway betw. 22nd & 25th Sts., at $36,385.

Pa., Sharon—W. McIntyre & Son, 330 S. Irvin Ave., award. contr. for bldg. san. sewers in Prospect Heights, at $50,000.

Va., Richmond—A. W. Manard, City, award. contr. for small connect'g sewers in northern sec., to connect with Bacon-Quarter Sewer, at $10,300.

Wash., Seattle—V. Ramaglia, 483 37th Ave., award. contr. for bldg. sewer in 25th Ave., N. E. (clay-pipe), at $59,260.

W. Va., Wellsburg—B. O. Cresap, local, award. contr. by city for bldg. lateral sewers in 3rd & 4th Wards, at $38,679.

Wis., Union Grove—F. E. Kaminski, Watertown, award. contr. for constr. of sewers and disposal tank, at $6,925.

WATER SUPPLY AND PURIFICATION

Ala., Talladega—Lane & Bowler, Chelsea Ave., Memphis, award. contr. for bldg. water sys., involv'g digging & install'g 3 deep wells and pumping into stand pipe of present sys., at $35,000.

Ark., Marvel—U. S. Sanitary Septic Tank Co., Exchange Bldg., Memphis, award. contr. for install'g waterworks & sewage plants, at $43,000.

Cal., La Canada—Paul H. Ehlers, 5618 Harold Way, Los Angeles, award. contr. for construct'g rein.-conc. reservoir at Flintridge for Valley Water Co., at $7,500.

Colo., Towaoc—R. A. Yoder, Gallup, New Mex., award. contr. for water intake, reservoir & sewers at Indian School, at $16,000.

Fla., Key West—Williams-Gerstle Engr'g Co., 198 Broadway, N. Y., award. contr. to constr. conc. tower & tank at $4,737.

Ill., Great Lakes—Chicago Brdg. & Iron Wks., Chicago, award. contr. for 100,000-gal. steel water tank, at $8,400.

Ind., South Bend—Kuehn-Jordon Co., City, award. contr. for construc. of conc. reservoir, at $6,693.

Kans., Eureka—J. S. Davis, City, award. contr. for improv'g water wks. sys., at $6,630.

Md., Indian Head—E. Christman, 416 McClymonds Bldg., Massillon, O., award. contr. for construct'g artesian wells at Naval Proving Grounds, at $55,685.

Neb., Hoskins—Merkle Mchny. Co., 1020 Woodmen of World Bldg., Omaha, award. contr. for engine & pump for waterwks. Farmers Lbr. Co., Hoskins, award. contr. for tower & tank, $10,000. Polk, Pa., Pittsburgh Filter Mfg. Co., Farmers Bk. Bldg., award. contr. by Bd. of Trustees State Inst. for Feeble Minded, for rapid sand filtra. plant & motor driven centrifugal pumps, in connec. with water supply, at $28,000.

Neb., Pender—Wright Elec. Constr. Co., Fremont, award. contr. for water & elec. light'g plant, at $10,989.

N. Y., Salamanca—G. Fred Miller & Son, City, award. contr. for bldg. municipal water & light plant, $26,000 cost of bldg. & equipment; the latter contracts being award. to outside concerns.

N. D., Minot—G. W. Kenner, City, award. contr. for laying water mains, at $3,250.

N. D., Minot—McCarthy, Well Co., St. Paul, award. contr. for sinking city well in W. Park, at $3,500.

O., Euclid—Gould & Mayback, Cleveland, San Francisco, award. contr. for grading

Cal., Sacramento—Erickson & Patterson, tion Banning-Palm Springs Rd., at $8,000. award. contr. for constructi'g 6-in. water mains in five streets, at $27,150.

O., Lorain—John Patterson, City, award. contr. for construct'g concrete foundation for new pump at water works, at $2,600.

Ore., Prineville—Portland Wood Pipe Co., Portland, award. contr. for construc. of pipe line across Ochoco Valley by Ochoco Irrigation Distr., 28 in. diam. on inside; matl., 1½-ins. thick, at $2.98 lin. ft., 2,580 lin. ft.

Tex., Port Arthur—H. W. Cardwell Constr. Co., City, award. contr. for installing 56,000 lin. ft. c. i. water mains, at $24,300.

Tex., Waco—B. F. & C. M. Davis, Ft. Worth, Tex., award. contr. for construc. of reservoir on Trice Hill, at $50,867.

Wash., Seattle—Florito Bros., award. contr. for install. of water mains on Alki Ave., at $57,825.

BRIDGES AND BUILDINGS

Ariz., Tombstone—Cochise Co. award. contr. to Topeka Brdg. & Iron Co., Kans. City, Mo., for bldg. rein.-conc. brdg. over San Pedro River, Luten arches, 70 ft. each, at $26,250.

Cal., Sacramento—Duncanson-Harrelson Co., San Francisco, award. contr. for constr. of rein.-conc. brdgs. on state hwy., Marin Co., at $32,689.

D. C., Washington—Savings & Trust Co., New York City, award. contr. for construct'g 7-span, steel plate girder brdg. on Benning Rd., at $180,000.

Fla., Tampa—Davis & Webb, Tampa, award. contr. for brdg. construction at $49,266.

Ia., Atlantic—Lana Constr. Co., Council Bluffs, award. contr. for following culverts: 1,600 ft. 15-in. pipe; 2,230 ft. 18-in. pipe; 56 ft. 30-in. pipe; 104 ft. 36-in. tile, etc., etc., at $5,972.

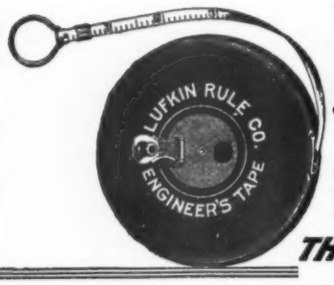
Ia., Dedham—Rickens Constr. Co., Sioux City, award. contr. for brdg. bet. town & railroad sta., at $7,200; also Alson Hansmonn brdg., at $5,500.

Ia., Ft. Dodge—Royce & Slater, Strat-

Faultless Service in Every Respect

THAT'S WHAT YOU NEED WHEN TAKING MEASUREMENTS

That's what you can rest assured you are getting when you use



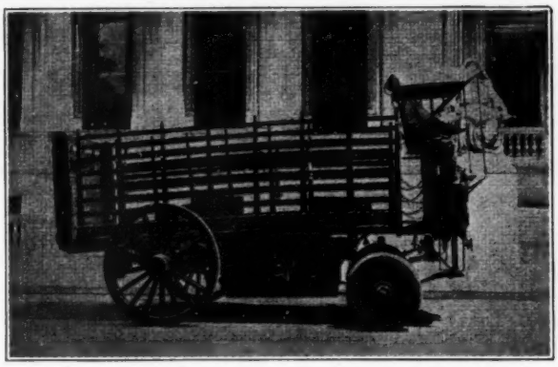
LUFKIN TAPES

PIONEERS IN CONNECTION WITH THE NOTEWORTHY IMPROVEMENTS MADE IN TAPES

More of them are in use than all other makes because they have for years consistently maintained the highest reputation. Send for Catalog No. 26.

THE LUFKIN RULE CO. SAGINAW, MICH.

NEW YORK. LONDON, ENG. WINDSOR, ONT.



Couple-Gear

Front and Four-Wheel Drive (Trucks and Tractors) keep out of the repair shop. They cost 50 per cent less to operate than gasoline trucks and 25 per cent less than any other type of storage battery truck.

97 Per cent of the power is applied at the point of traction. Load strain is taken off the driving mechanism. But let us send you the illustrated story.

COUPLE-GEAR FREIGHT-WHEEL CO.
GRAND RAPIDS, MICH.

Chicago Sales Agents—Couple Gear Power Truck Co.
1029 Peoples Gas Bldg.

SPECIFY WARREN
Cast Iron Pipe

For Water, Gas, Culverts, Sewers

We specialize in Bell and Spigot and Flanged Special Castings. Also flexible Joint Pipe, Cylinders, Tubes, Milled and Plain Ends—High Pressure Fire Service Pipes.

Warren Foundry & Machine Co.

Sales Offices:
Bowling Green Bldg., New York.
201 Devonshire St., Boston, Mass.
Works: Phillipsburg, N. J.
"Quality and Service Guaranteed"

Fire Department Supplies

THE OLDEST AND LARGEST MANUFACTURER OF EVERYTHING USED IN A FIRE DEPARTMENT

S. F. HAYWARD & CO.

39 PARK PLACE. **NEW YORK CITY.**

Two Letters from the Same Concern

If you imagine that our Daily Contract News Bulletins contain less information on "Contracts Awarded" and "Bids Asked" (than a year ago)—you are mistaken. We've *re-doubled* our efforts and *increased* our sources of information. Our Daily Bulletins contain *more* tips than ever before. The left hand paragraph is what a leading manufacturer of Contractors' Machinery wrote before he used our Daily Advance Contract News Bulletins. The right hand paragraph is what this same manufacturer afterwards wrote:

"We will shortly discontinue all subscriptions to Bulletin Services on account of recent lack of worth-while information on 'Bids Asked' and 'Contracts Awarded.'"

"We find that the Daily Bulletins of *Municipal Engineering* (for January, 1918) contain more 'Bids Asked' and 'Contracts Awarded' than any four sources combined."

ford, award. contr. for rein.-conc. & steel brdgs. & culverts, at $11,995. J. J. Cain, Claire, contr. at $7,359.

Kans., Junction City — Leavenworth Brdg. Co., Leavenworth, award. contr. for construct'g rein.-conc. brdg. across Republican River, at $45,000.

Kans., Kansas City—Ark. Brdg. Co., Waldheim Bldg., Kans. City, award. contract for construct'g Central Ave. viaduct, at $186,000. Main struc. 900 ft. in length; secondary approach, 460 ft.

Kans., Kans. City—E. J. Wetterstrom, 1117 Rialto Bldg., award. contr. for bldg. 1,500 ft. steel & rein.-conc. viaduct, at $250,000.

Me., Bar Harbor—Nelson & Spellman, Bangor, award. contr. for Mt. Desert Brdg., at $84,000.

Minn., Mazeppa—The Widell Co., Mankato, award. contr. for sub-struc. for reconstr. Old Red Brdg., at $8,700.

Minn., Rochester—Widell Co., Mankato, award. contr. for piers and abutments for Red Bridge, north of city, at $8,674.

Minn., Windom—Joliet Brdg. & Iron Co., 731 Met. Life Bldg., Minneapolis, for Bridge No. 2,773 across Des Moines river, at $5,100.

Mont, Hardin—Security Brdg. Co., 741 Met. Bk. Bldg., Minneapolis, Minn., award. contr. for 2, 100-ft. steel spans across Little Big Horn river, at $9,998.

Mont,, Lewiston—Iowa Brdg. Co., 717 McKnight Bldg., Minneapolis, award. contr. for construct'g 2, 150-ft. combination span brdgs. for Dawson and Fergus Counties, at $16,436.

Mont., Mosby—Iowa Bridge Co., local, award. contr. for putting in Dawson-Fergus. Co. brdg. across Musselshell, at $164,361.

Mont., Myors—Security Brdg. Co., Billings, award. contr. for construct'g brdg. 152-ft. steel span. conc. pier 40 ft. high, at $11,800.

Neb., Beatrice—Illinois Steel Bridge Co., Jacksonville, Ill., award. contract for steel bridges, at $3,243.

Neb., Lincoln—Martin Constr. Co., Lincoln, award. contr. for brdg. constr. over W. Middle Crk., at $7,500.

Neb., N. Platte—Edw. F. Pettis, Lincoln, award. contr. for brdg. across So. Platte river, at $10,000.

N. J., Hoboken—Nolan & Hornung Constr. Co., award. contr. for improv'g 14th St. viaduct, at $62,472.

N. J., Jersey City—Nolan & Hornung Constr. Co., 143 Summit Ave., W. Hoboken, award. contr. for improv'g 14th St. viaduct, at $62,471.

O., Youngstown—Henderson Constr. Co., 206 Dollar Bank Bldg., City, award. contr. for bldg. temp. brdg., New Himrod Brdg. to Cedar St., at $11,541.

Okla., Okla. City—Reinhart & Donovan, City, award. contr. for constructing brdg. over by-pass at waterwks., at $5,789.

Okla., Stillwater—Canton Brdg. Co., Kans. City, Mo., award. contr. for constr. of brdg. over Cimarron River, at $20,625.

Pa., Harrisburg—M. B. W. Stebbins Constr. Co., Wellsboro, award. contr. for bldg. bridge at Nelson, at $45,000.

Pa., Nelson—G. A. Schreiner, Supt. Pub. Grounds & Bldgs., Harrisburg, award. contr. for bldg. brdg. at Nelson, to M. W. Stebbins Constr. Co., Wellsboro, at $45,000.

S. C., Charleston—Austin Bros., Atlanta, Ga., award. contr. for steel draw brdg. & timber approach over Dawhoo River, at $28,500.

Tenn., McGhee—Burgett & Sarim, Memphis, award. contr. for steel bridge over Little Tenn. River, at Indian Rock, at $17,500.

Tex., Dallas—S. M. Haley, City, award. contr. for culvert on Victor St., at $15,644. Kelin Bros., award. contr. for conc. culv. on Forest Ave. extension, at $4,676.

W. Va., Fairmont—The John F. Casey Co., Pittsburgh, award. contr. for construct'g brdg. over Monongahela River, at $40,000.

Wis., Madison—Wausau Iron Wks., Wausau, award. contr. for construct'g steel riveted truss brdg., 4 spans, 140 ft. long, at $53,400.

Wis., Oakwood—Milwaukee Constr. Co., 857 8th Ave., Milwaukee, award. contract for 2 conc. brdgs.; 1, 112-ft., $10,700; 1, 350-ft. span, $2,700.

Use Your Influence

Permanent Highways

A Federal Highway Board Should Encourage Immediate Construction of Permanent Roads Connecting our Larger Cities.

IN ORDER TO RELIEVE FREIGHT CONGESTION, MOTOR TRUCKS are being more and more extensively used in the inter-city and inter-state haulage of freight. Trucks are now seen on every Highway in the Country. The Immediate construction of *Permanent* roads to withstand this traffic is a WAR NECESSITY!

AMERICAN FARMERS HAVE BEEN APPEALED TO FROM EVERY source to increase their crops that the world may be supplied with food and that the price may be kept down. More thoroughly organized freight and express service (via Motor Trucks) *could* be adopted by communities suffering from freight congestion *if* our Highways *would* withstand the traffic.

AS WE WERE UNPREPARED IN SHIPPING AND IN RAILWAY REQUIREMENTS, in munitions and war supplies, so are we also unprepared in the physical conditions of our highways. Our roads must be *immediately* developed and Improved.

PERMANENT HIGHWAYS, CONNECTING OUR LARGER CITIES, are not a luxury! They are a NECESSITY. Motor Trucks are ready at hand:—for the freightage of commodities and the construction of the Highways. Labor must be employed. Money must be kept moving. The Highways of the country must be improved. A Federal Highway Board is urgently needed.

Use Your Influence

PROSPECTIVE WORK

ROADS AND STREETS

Ala., Clayton—Barber Co., Commrs. contemplate construc. of 7 mi. of hwy., Eufaula to Clayton. Est. cost, $24,000.

Ark., Eureka Springs—Plans under way for bldg. macad. rd. in Carroll Co., Eureka Springs through Green Forest and Alpena to Green Co. line. Est. cost, $158,000.

Ark., Harrisburg—Plans have been made for 17 mi. of rd. construc. in Pointsett Co Approx. cost, $38,000. Work will consist of more than 100,000 cu. yds. excav. & 1,300 ft. iron culvert.

Ark., Helena—Phillips Co. Commrs. have plans by State Hwy. Comm., for asph.-macad. rd., 16 miles in length. Est. cost $225,000.

Ark., Little Rock—State Hwy. Comn. has decided to bld. 11 mi. rd., Pope Co. Est. cost, $45,000.

Ark., Newport—Plans being prepared for 33 mi. gravel rd., Jackson Co. Abt $212,000.

Ark., Pocahontas—Randolph Co. Commrs. contemplate 10-mi. macad. rd. Have plans by State Hwy. Dept., Little Rock. Est cost, $61,000.

Ark., Russellville—Rd. through National Forest authorized; $43,000 has been set aside by Interior Dept., which will be supplemented by state funds for this purpose.

Ariz., Phoenix—Work will probably start in March on hwy. betw. Prescott & Jerome via Yeager canyon.

Cal., Alameda—City considering proposal to widen Clement Ave., its entire length to 100 ft.

Cal., Los Angeles—City planning to pave Manchester Ave. $20,000 will be available for this purpose.

Cal., Riverside—Following rd. work planned by Riverside County: 15,300 ft grading & gravel'g on Lovekin Blvd.; 19,856 ft. Hobsonway; 10,000 ft. Fertilla Rd., 5,264 addn. ft. grading. Rdways will vary 10 to 20 ft. in. width; rein.-conc. brdgs., culverts, crossings, etc., will also be built. 1 mi. rd. at Wineville (Stiwanda Ave.) to be improved, conc. on macad.

Cal., San Diego—Petition filed by citizens for paving of coast highway to Torrey Pines grade. San Diego and La Jolla Chambers of Commerce, also Merchants' Assn., interested.

Cal., Stockton—Plans being prepared by Co. Engr., F. E. Quail, for improv. of 7 miles Clements-Ione Rd.

Cal., Oakland—City Council has passed resolution to pave 7th St., from Bay West to Albers Bros. Milling Co. Approx. cost, $170,000.

Fla., Jasper—$400,000 bonds voted by Hamilton County. This includes 30 mi. brk. or asph. rd., Georgia state line to Suwanee Co. line at White Springs (abt $250,000). Surplus to be used for hard-surfac'g lateral rds. in east district. State & Fed. aid, $50,000.

Fla., Lake City—Rd. bonds passed at recent election. Brick rd. to be built from Georgia line, via Lake City to Jacksonville (sand clay will be used in Baker County).

Ct., Bridgeport—Plans being prepared by C. H. Terry, City Engr., for extend'g Broad St., tunneling under Golden St. & bldg. plaza on Lyon Terr. Est. cost, $240,000.

Ill., Chicago—City contempaltes bldg. boulevard betw. 94th and 119th Sts.

Ill., Chicago—City contempaltes grading & paving with asph. W. 18th St.; grading & paving with 7-ins. Portland cement conc., rdways of alleys betw. Sunnyside, Montrose, N. Ashland & N. Paulina; same work on rdways. of alleys betw. Altgeld, Fullerton, N. Sawyer & N. Spaulding; betw. W. Harrison, Flournoy, S. Sacramento Blvd. & S. Albany, and various others.

Ill., Winnetka—Winde & Marsh, Engrs., Winnetka, preparing plans for paving 62,000 yds. Winnetka Ave., with conc. Kenilworth also interested. Approx. cost, $200,000.

Ia., Burlington—Supvrs. Woodbury Co. contemplate paving every main rd. in county, abt. 100 miles.

Ia., Clinton—Clinton Commercial Club has petitioned the Governor, also Commercial Clubs & State Hwy. Comns., for paved road from City to Omaha.

Ia., Des Moines—Extension paving contemplated by City as follows: Eaton Blvd., 18th to 33rd St., $40,000; 28th St., $32,000; Dean Ave., $20,000; Indianola Ave., $25,000; Euclid, 2 miles, $50,000. In addition 359,538 sq. yds. unfinished paving will be commenced & completed.

Ia., Hardin—$125,000 appropriation made for 18 blks. bithu. paving.

Ia., Iowa City—6½ miles of Kalona Rd. will be paved by Johnson Co. Est. cost, $32,000. A. F. Fisher, Co. Engr.

Ia., Manson—Plans under way for grading & gravel'g portions of Main St., Howard, Pine, 2nd, 3rd, Willey Ave. & Hamilton St.

Ia., Marshalltown—Story Co. will have $36,000 available for permanent grading; $10,000 for gravel'g. H. O. Hickok, Co. Engr., W. E. McCleland, Aud.

Ia., Sioux City—J. C. McLean Co. Engr. will submit plans for proposed rd. from Sioux City to Moville, Correctionville, Cushing & Smithland (after going over same with federal engineer), to Public Rds. Comn., Washington. Fed. aid to amt. of $68,500 will also be asked. Estimated 500,000 cu: yds. earth will be removed in the construction; in addition to grading, conc. culverts, etc., bridges & pipes will be put in.

Kans., Baxter Springs—Plans being prepared by A. C. Moore, Engr., Joplin, Mo., for improve. of abt. 60 blks. in bus. section.

Kans., Topeka—Petitions presented for 12 blocks paving; additional blk. to be asked for by Commr. W. L. Porter, Jefferson St., thru Euclid Park, from 15th to 17th.

Kans., Topeka—Kans. Good Rds. Assn. interested in plan to bld. 19 mile rd. to Dover. Approx. cost, $304,000. J. F. Smith, Pres. State Hwy. Comn. has approved petitions for Fed. aid for 27 mi. conc, rd., 16 ft. wide, city to Lawrence, & Leavenworth Co. line. W. S. Gearhart, State Hwy. Engr.

Ky., Louisville—A 16-mile road (brk. or conc.) is under consideration by Clark County. Est. cost betw. $18,000 and $20,000.

Mich., Boyne City—Two road bond issues have been voted by Charlevoix County; one for $250,000, the other for $100,000. Funds will be used for Dixie Hwy., main and tributaries of Mackinaw Trail.

Mich., Escanaba—Resolution drawn up by City Council to grade and pave Stephenson Ave. with bithu. Approx. cost, $27,000.

Minn., Bemidji—$80,000 available for roads and bridges in Beltrami Co. during 1918. J. L. George, Co. Aud.

Minn., Minneapolis—Following improvements planned by Hennepin County: bldg. 20 mi. River Rd., in Dayton, $40,000; grading & surfac'g 21 mi. Osseo Rd., $80,000; widening 4 mi. Superior Blvd. (conc.). $18,000; grading, surfac'g & gravel'g Excelsior Ave., $75,000; grading Rockford Rd., $40,000; resurfacing Lake St., $5,000; also various other improvements, $50,000. A. P. Erickson, Co. Aud.

Minn., Minneiska—Road to be built betw. here & Minnesota by Winona Co. Govt. aid. H. B. Childs, Dist. Hwy. Engr. preparing plans. Est. cost, $24,000. C. W. Anding, Co. Aud., Winona.

Minn., Ortonville—Big Stone Co. plans to spend $40,000 on road improvement in 1918. A. V. Randall, Co. Aud.

Minn., So. St. Paul—$100,000 bonds voted at recent election for purpose of paving Concord St.

Mo., Fulton—Millersburg Special Rd. Dist., Millersburg, Mo., will macad. 7 miles Old Trails Rd. $35,000 available. Calwood & Williambsurg Special Rd. Dist. also planning to hard-surface 16 miles Old Trails Rd. $75,000 available.

Miss., Iuka—Bonds to amt. of $30,000 have been sold. Funds will be used for bldg. section of Mussel Shoals hwy.

Mo., Independence—Jackson Co. Comrs. planning to pave Van Horn Rd. betw. City and Kansas City, with brk., 3½ mis. Est. cost, $100,000. O. C. Sheley, Co. Hwy. Engr.

Mo., Jefferson City—Plans under way for construct'g 30 mi. rd., 20 ft. wide, Cole County. Approx. cost, $90,000.

Mo., St. Joseph—Bd. Pub. Wks. contemplates paving with Trinidad Sheet Asph. Olive St., 15th to 26th.

Mo., Salem—Plans being prepared for construct'g Salem, Licking and Iron Mtn. rds. Approx. cost, $160,000. J. H. McDonold, Co. Clk.

Mont., Great Falls—City contemplating 9,000 sq. yds. bithu. paving. L. B. Emerson, City Engr.

Mont., Missoula—Requests being received by Forest Service for Fed. aid in construc. of abt. 12 mi. through forests. Est. cost, $24,000.

N. J., Camden—$112,000 appropriation for roads approved by City Council.

N. J., Newark—Following improvements authorized by Commissioners: paving W. Kenney St., Lyons Ave., Verona Ave., repaving S. 10th St., Lincoln Ave. & Heller Pkway. with asph.; resurfac'g Newton, Lafayette & Niagara Sts. (asph.); repaving Ferry St. with reclipped granite blk. M. R. Sherrerd, Chief Engr.

Truck Trains are Running (on schedule) from Akron, Ohio, to Boston.

And from Detroit to New York City! And from Chicago to St. Louis! The inter-city and inter-state haulage of freight via Motor Trucks on our Roadways is *a Fact!*

Motor Trucks are no longer vehicles of cities and towns—we see them on every road in the country, but in order to effect the maximum economy, we should *speed* the construction of Permanent Highways connecting our larger centers. Such Highways are *not* a luxury—they are a **necessity.**

Doing Our Bit

Address reply to QUARTERMASTER GENERAL, Washington, D.C.

WAR DEPARTMENT.
OFFICE OF THE QUARTERMASTER GENERAL OF THE ARMY
WASHINGTON.

Attention: Lt. Col.H.A.Hegeman, 1421 "I" St. N.W.

Nov. 23, 1917.

No.

From: The Quartermaster General.

To: MacRae's Blue Book Company, Railway Exchange, Chicago, Ill.

Subject: Copies of Blue Book.

1. Replying to your letter of Nov. 17th this office would appreciate receiving 4 copies of MacRae's Blue Book addressed to

Lt. Col. H.A.Hegeman, 1421 "I" St. N.W.
Major J.E.Hickey, 1421 "I" St. N.W.
Capt. H. W. Ross, 1421 "I" St. N.W.
Capt. A. P. Shirley, 1421 "I" St. N.W.

2. These copies will be used by a Purchasing Branch in France in requesting material to be purchased in this country.

3. This office wishes to thank you in advance for your kind offer, and trust that these books will be received promptly.

Henry G. Sharpe,
Quartermaster General.

By [signature]
Col., G.S. Corps.

HWR/LAC

Address reply to CHIEF OF ENGINEERS, U.S. ARMY, Washington, D.C.

WAR DEPARTMENT
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON

AMD-MES

September 12, 1917.

MacRae's Blue Book Company,
Railway Exchange,
Chicago, Ill.

Gentlemen:

The complimentary copy of MacRae's Blue Book which you furnished this office in May of this year was taken to France by an Engineer Official detailed with the American Army, for his use in ordering material, machinery, etc.

It would be of great assistance to this office if you could furnish it with one or two additional copies of your valuable publication. Franks covering postal transmission are herewith.

Very respectfully,

W.M.Black
Chief of Engineers, U. S. Army.

By [signature]
Major, Corps of Engineers.

MATERIAL FOR FRANCE

More than 300 Army and Navy Officers have been equipped with copies of **MacRae's Blue Book.**

A copy of the 1918 edition will be placed in the hands of all officers buying supplies for the Army and Navy.

11,000 copies ANNUALLY. ***Supreme*** **in the Railroad field.**
The *Favorite* in the Industrial Field.

For representation in the 1918 edition of **AMERICA'S GREATEST BUYING GUIDE** write at once to

MacRae's Blue Book Company

Railway Exchange **CHICAGO, ILL.**

N. J., New Brunswick—Bd. of Freeholders, Middlesex Co., plan to pave Highland Park-Bound Brook Rd. Approx. cost, $300,000.

N. J., Trenton—Plans approved for constr. of vehicular tunnel under Hudson river from Canal St., New York, to 12th St., Jersey City. Cost not to exceed $12,000,000.

N. M., Sante Fe—Glorieta-Panchuelo Rd., Pecos to Panchuelo Ranger Sta., has been designated as State Hwy. No. 63. Fed. & state aid approved on Carlsbad-Monument rd., Eddy & Lea Counties; also on Rd. No. 18, Union Co. State Engineer authorized to submit est. for state & Fed. aid on Almogordo-Valmont Rd., on Rd. No. 5, Socorro Co. Rd. from Taos to Taos Jct., also accepted as State Hwy.

N. Y., Rochester—Ordinance adopted for paving Hollenbeck St. Approx. cost, $45,000.

N. Y., Rochester—City contemplating paving portion of Thurston Rd. with asphalt; Jones St. with brick. Cost abt. $21,000 & $15,000 respectively. F. Elwood, City Engr.

O., Akron—$737,000 will be expended for the extension & paving of Cleveland Rd. Chas. J. Costigan, Co. Surveyor, Summit Co.

O., Canton—Starke Co. has asked for $80,000 Govt. aid for construc. of 2 roads; one running through Osnaburg, Paris, New Franklin & Minerva; the second from Louisville to Ravenna; total mileage 6 to 7 miles. State aid for like amt. expected.

O., Cleveland—Ord. passed for issuance of $400,000 bonds to pay for opening, extending, widening & improv'g Carnegie Ave., E. 89th St. to E. 107th St.

O., Toledo—Plans being prepared by City Engr. for improv'g 50 streets. Approx. cost, $1,500,000. Issuance of $150,000 in bonds for Dept. of Parks & Blvds. has also been approved.

O., Wooster—Wayne Co. Commrs. have decided to pave following roads: Lincoln Hwy. west to county line, 6.71 miles; Wooster-Mansfield Rd., 1.23 miles; Wooster-Creston Rd., 5 mi. Est. cost, $184,000, $28,000 and $128,000 respectively.

Ore., Eugene—Contracts signed by federal government, state & Lane Co. for constr. of 15.9 miles standard rd., Rainrock to western boundary of Siuslaw national forest. Government & State will spend $46,000 each, County $30,000. Co. Court has appropriated $5,000 for rd. from Aema to Cushman.

Ore., Hillsboro—Washington Co. budget includes $35,000 for special rd. improvements; general rd. improvements provided for by County Rd. fund at $96,000.

Ore., Pendleton—State Hwy. Assn. has set aside an appropriation to gravel Columbia River Hwy. from The Dalles to Pendleton, 50 miles.

Ore., Portland—City will have available for highway & brdg. constr. and maintenance, $90,233; $35,820 for sewers.

Pa., Harrisburg—Plans for following road construction approved by State Hwy. Dept.: State Route No. 65, Clarion Co., $26,750; No. 108, Allegheny & Washington Counties, $64,800; No. 52, Cambria Co., $62,340, and others. J. Denny O'Neill, State Hwy. Comr.

Pa., Hollidaysburg—Plans being prepared by Co. Engr. for 15 miles of road in Tyrone and Logan Twps.

Pa., Philadelphia—White Horse Pike (Phila.-Atlantic City motor route) is to be paved for three-fourths of distance across state with conc. and will be 20 ft. wide. $500,000 appropriation.

Pa., Pittsburgh—Plans under way for rein.-conc. blvd. (50 ft. wide) betw. E. Carson St. & McKeesport. Est. cost, $650,000.

S. D., Pierre—State Hwy. Comn. planning to spend abt. $40,000 for asph.-macad. rds., Minnehaha Co.; also abt. $200,000 for gravel rds., Codington, Deuel, Grant, Moody, Brookings & Lincoln Counties. Frank S. Peck, State Hwy. Engr., Deadwood.

Tex., Dickens—$28,000 appropriation made by State Hwy. Comm., for constr. of Fort Worth-Roswell Hwy. through county. Plans are being made for bldg. 260 mi. gravel rdway, for which addn. appro. of $400,000 will be made, in connec. with bond issue.

Wash., Spokane—City contemplates 40,000 yds. paving which, in conjunction with improvements necessary to make this paving possible, will amt. to abt. $120,000. Abt. $25,000 will be expended for grading, curb'g & sidewalk contr. A. D. Butler, City Engr.

Tex., San Antonio—City contemplates another bond issue of one to two million dollars for additional pavements, conc. brdgs., also exten. of present sewer laterals.

SEWERAGE AND SEWAGE TREATMENT

Cal., San Diego—City having plans prepared for storm drain in Canyon St. Approx. cost abt. $25,000. G. Cromwell, City Engr. Plans also being prepared for install'g ½-mile 4-ft. storm drain (conc.) in Evergreen St., Addison to Emerson. Abt. $25,000.

Ga., Atlanta—City planning to construct trunk sewer in several streets; also storm water sewer on Stewart and Joe Johnson Ave. Est. cost, $92,285.

Ga., Columbus—San. Comm. recommends construc. of san. sewer sys. Est. cost, $350,000.

Ida., Preston—Bond issue of $50,000 voted for purpose of construct'n sewerage sys. J. Johnson, City Clk.

Ill., Chicago—City planning extensive improvements on sewage plants. Treatment plants will be erected at various points. Plans call for the filling up of Bubbly Crk. Pumping stas. will also be built at Calumet, Des Plaines and Evanston Distrs.

Ill., Chicago—City having plans drawn for erec. of pumping sta. at 125th St. & Indiana Ave., for sewage disp. of Calumet intercept'g sewer. Pump designed to lift sewage over Mich. Ave. ridge into outfall sewer, that will empty into new Calumet-Sag. canal at Stony Crk., Blue Island.

Ill., Quincy—City is contemplating bldg. 3 miles of sewers.

Ia., Burlington—City plans bond issue of $22,500 for sewer improvements.

Ia., Des Moines—Plans under way for two big sewer systems, one in W. Des Moines, at abt. $500,000, the second in E. Des Moines, lying north of fair grounds and betw. 29th and 33rd Sts., at abt. $70,000.

Ia., Iowa City—Plans being prepared for storm sewer, Dodge to Lucas St. Abt. $15,000. S. N. Hands, City Engr.

Kans., Hutchinson—Ben Lee, City Engr., has prepared preliminary plans and estimates for East Side drain. Est. cost, $80,000. Sewer at start will be 33-in. con., end'g with 18,400 ft. 42-in. conc.

Kans., Marquette—Plans prepared by E. T. Archer & Co., Engrs., New England Bldg., Kans. City, Mo., for bldg. sewerage sys. Abt. $20,000.

Kans., Newton—Sewage disp. plant contemplated by city. Est. cost, $65,000. Black & Veatch, Engrs.

Kans., Wichita—Plans being prepared for bldg. san. sewer No. 20, 5 mi. long. Est. cost, $180,000. P. L. Brockway, City Engr.

Ky., Owensboro—Bids soon to be called for on bldg. new sewers. E. A. Shifley, City Engr. Approx. cost, $421,715.

Ky., Paris—Bond issue of $20,000 voted for construct'g sewer system. J. W. Hayden, City Clk.

Ky., Shelbyville—Ord. passed for issuing $15,000 bonds for extension of sewerage sys. to Fairview and Catalpa Court Addns. D. R. Lyman, City Engr.

Md., Hagerstown—Surveys being made in Blair's Valley for construc. of reservoir to increase water supply in Hagerstown.

Mass., Boston—Plans under way for following sewer construction: 10-in. san., Bellamy St. ($1,500); 24-in. surf. drain, Stanwood St. ($2,600); 12-in. san. sewer Beaver St. ($1,100); 3 surf. drains and 9 catch basins Irma St. ($3,975).

Minn., Butterfield—Plans are being prepared for sewer construction by Krall & Krall. St. James, Engrs. Est. cost, $40,000. Jno. F. Enns, City Clk.

Mo., Kane City—Trunk line sewer on Troost Ave. will be readvertised. Contract has been rescinded. Est. cost, $160,000.

Neb., Fremont—Plans being prepared by Burns & McDonnell. 402 Inter-State Bldg., Kans. City, for sewage disp. plant. Abt. $75,000.

Neb., Omaha—City contemplating 4 mi. water main. Est. cost, $60,000. J. A. Bruce, City Engr. to Ft. Crook.

N. J., Lyndhurst—Ord. passed for issuance of $200,000 bonds for sewer sys.

N. J., Springfield—Town contemplating bldg. portion of Rahway Valley trunk sewer in conjunction with other municipalities. $61,000 will be appropriated by town toward cost.

N. M., Las Vegas—City Council has passed an ord. for bldg. sewers throughout city. Abt. $31,000.

N. Y., Brooklyn—Board of Estimate has authorized sewer construction as follows: Moore St., cost $6,700; Rockdale St., $2,000; Sanford Ave., Forbes to Gerold, and in Gerold, Sanford to Lucerne, $2,000.

N. Y., Brooklyn—City will construct sewer system in Jamaica Village and section to south, east and west of old village of Jamaica. Sewers will drain abt. 3,800 acres.

N. Y., Long Isl. City—Resolutions adopted by Newton Bd., for construc. of 4 sewers to drain Steinway, N. Woodside, N. Winfield & Jackson Heights. Approx. cost, $2,672,200. Work will be divided into four contracts.

N. Y., Long Isl. City—City contemplates following sewer improvements: In Moore St., L. I. City, $6,700; Rockdale St., L. I. City, $2,000; Sanford Ave. & in Gerold St., Flushing, $2,000.

N. Y., Manhattan—Resolution adopted for construct'g sewer E. 26th St., Madison Ave. to East River; reconstruct'g exist'g sewer Madison Ave., E. 25th to E. 31st etc., etc., aggregate length, 1 mile.

N. Y., Syracuse—City contemplates bldg. new sewage disp. plant and incinerating plant. H. C. Allen, City Engr.

N. C., Durham—City will enlarge Third Fork Crk. disp. plant; also install addn. sand filter. $51,000 available. Geo. W. Woodward, City Clk.

O., Cincinnati—$54,500 bonds will be issued by City for purpose of bldg. sewers on California Ave., Reading Rd., Bank St., and others. F. S. Krug, City Engr.

O., Cleveland—City plans to bld. sewers in E. 124th, 125th, 126th, 127th, 128th Sts., at $13,144; Corlett Ave., S. E., and E. 116th St., at $50,000.

O., Cuyahoga Falls—$100,000 bonds being sold for install. of sewers and constr. of sewage disp. plant.

O., Niles—Ord. passed for issuance of $18,000 bonds to pay for portion of expense in construc'g intercepting sewer. Homer Thomas, Clk.

O., Rocky River—Bids to be asked shortly for construct'g sewerage sys. and sewage disp. plant. Est. cost abt. $90,000. E. H. Arnold, Vil. Engr.

O., Springfield—Plans under way for construc. of sewer in Willis Ave. Est. cost, $7,380.

O., Toledo—City Council has passed Ord. for issuance of $800,000 bonds for purpose of starting work on sewer system.

Okla., McAlester—City planning to extend sewage disp. plant; also outfall sewer. Approx. cost abt. $50,000. A. H. Kindrick, City Engr.

Okla., Miami—City will construct sewer & water extensions to Miami Heights, 10,000 ft. 10-in., & 3,000 ft. 8-in. pipe. Est. cost, $32,000. Hughes Engrs. Co. Engrs., 310 Bank of Com. Bldg., Tulsa.

Okla., Pilcher—Abt. $30,000 available for sewerage system.

Pa., Beaver Falls—Plans being prepared for san. sewerage sys. for Boro, $36,000 bonds voted for purpose. H. Dawson, Boro Engr.

Pa., Erie—City plans construc. of intercept'g sewer sys., & sewerage plants. Three separate plants are to be built; one on water lots purchased from Penn. R. R.; one at mouth of Four-Mile Crk.; one just east of Waldameer.

Pa., Harrisburg—State Health Dept. approves plans for water & sewer sys. at shipbldg. plants Hog Isl. & Bristol, 2 water & 2 sewer sys. to be constructed at each place; also storm water sewers.

Pa., Penn Sta.—City having plans prepared for sewage sys., involv'g 8,000 lin. ft. san. terra cotta pipe. T. P. Herron, Engr., Irwin. Cost, $25,000.

Pa., Pittsburgh—Ord. passed for sewer construc. on private property Pittsburgh Ry. Co. & Mango Way, Platt Ave. to Hargrove; with branch sewers on Sebring, Traymore & Platt Aves. $13,000 est. cost.

Pa., Pottstown—Plans being prepared by E. C. Collins, Engr., 511 Drexel Bldg., Philadelphia, for extension of sewer to low level, 5 or 6 mi. Abt. $100,000. J. K. Klinck, Chmn.

Pa., W. Middlesex—L. D. Tracey, Engr., 245 4th Ave., Pittsburgh, preparing plans for Boro for sewerage sys. & sewage disp. plant. F. H. Bair, Colonial Trust Co., Farrell, Secy.

Pa., Rutledge—City contemplates bldg. 4 miles of sewers. $25,000.

Pa., Wesleyville—City having plans prepared for bldg. san. sewerage sys. & sewage disp. plant. B. E. Briggs, Engr.

S. C., Columbia—City planning to bld. outfall sewer 6 mi. long. Abt. $49,000. T. K. Legare, City Engr.

Tenn., Knoxville—City considering bldg. water sys. through lower S. Knoxville to Vestal. $53,000. J. B. McCalla, City Engr.

Tex., Waco—$225,000 bonds have been voted for purch. of site & erec. of sewage disposal plant in Waco.

Utah—Ogden—City plans to bld. sewers in Dist. 138. Abt. $28,000. 17,500 ft. pipe. M. J. Tracey, City Egnr.

Wash., Seattle—Specifications prepared

26th ANNUAL EDITION (1917--1918)

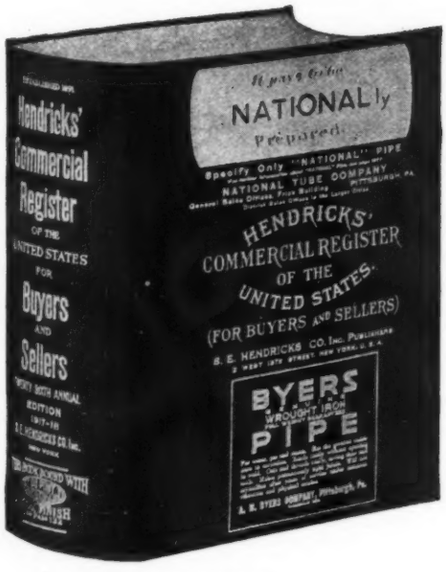
Hendricks' Commercial Register

For Buyers and Sellers

In this NEW ALPHABETICAL SECTION

Comprising the name of every concern appearing in the various classifications arranged in one alphabetical list to names with their principal industry and address.

A COMPLETE and RELIABLE Annual Register *especially* devoted to the interests of the Architectural, Contracting, Electrical, Engineering, Hardware, Iron, Mechanical, Mill, Mining, Quarrying, Railroad, Steel and Kindred Industries.


Hendricks' Commercial Register OF THE UNITED STATES FOR Buyers AND Sellers
NATIONAL ly prepared
Specify Only "NATIONAL" PIPE
NATIONAL TUBE COMPANY
HENDRICKS' COMMERCIAL REGISTER OF THE UNITED STATES (FOR BUYERS AND SELLERS)
BYERS
WROUGHT IRON
PIPE

Full lists are included of Producers, Manufacturers, Dealers and Consumers, listing all Products, from the Raw Material to the Finished Article, together with the concerns handling these Products, from the Producer to the Consumer.

CONTENTS

Classified Trades Section—In this section will be found arranged under lists of products the names and addresses of the manufacturers, etc., of the various articles mentioned.

Trade Names and Brands Section—Furnishes a ready reference to Purchasing Agents and Prospective Buyers to distinctive products manufactured by firms listed in the book.

Alphabetical Section—This list enables anybody to at once find the address, etc., of any concern with whose products they may not be familiar, thereby obtaining the desired information without loss of time.

Price Ten Dollars, Delivered

Used by the United States Government, Municipalities, Public Service Corporations and the largest firms and corporations in the States and Canada.

PUBLISHED EXCLUSIVELY BY

S. E. HENDRICKS CO., Inc.,

2 West 13th Street, New York City.

for sewers in Baker Ave. Est. cost, $4,000. 850 ft. 8-in.; 407 ft. 15-in.

Wash., Spokane—City will expend abt. $30,000 for sewer construction this year.

Wis., Waukesha—Council has authorized bond issue of $10,000 for bldg. of sewers.

WATER SUPPLY AND PURIFICATION

Ariz., Williams—Olmstead & Gillelen, Hollingsworth Bldg., Los Angeles, have been commissioned to prepare plans and specifications for proposed water works sys. Est. cost, $55,000.

Cal., Delano—Ord. passed for issuance of $45,000 waterwks. bonds.

Cal., Vail—$11,000 bonds voted recently for purpose of construct'g water & light system.

Fla., Key West—City contemplates water system. Abt. $1,000,000. B. C. Moreno, City Engr.

Ida., Buhl—City contemplates water supply sys. Supply from Antelope Sprgs. will cost $350,000, necessitating a 40-mi. pipe line; Clear Lake water, $80,000 to $100,000. Burns & McDonnell, Engrs., Kans. City, Mo.

Ida., Fort Hall—Recommendation made by W. A. Havenor, Special Engr., that Fort Hall water sys. be rebuilt. Est. cost abt. $500,000.

Ida., Twin Falls—Burns & McDonald, Engrs., 400 Inter-State Bldg., Kans. City, Mo., preparing plans for city for bldg. water sys., includ'g filtra. plant (4,000,000-gal.), 83 new fire hydrants, & 4-in. mains residence distr. Abt. $372,011.

Ill., Chicago—City contemplating construct'g & laying c. i. water supply pipe with special castings, fire hydrants, valves, etc., etc., in following streets: Wentworth Ave., W. 93rd St., Clyde Ave. & E. 104th Pl.

Ill., Chicago—Water Bureau is urging large exten. of metering system. City Engineer Ericson also recommends filtration system to be placed in water plant. Construction work estimated at abt. $20,000,000.

Ind., So. Bend—City contemplates bldg. 225,000-gal. reservoir. F. J. Anderson, City Engr.

Ia., Dubuque—Water Trustees have asked appropriation of $87,000 for water improvements: 2 new wells, $20,000; pump, $12,000; cover for W. 3rd St. reservoir, $30,000; duplicate turbine condenser, $20,000; vacuum pump, $1,000; new pump & repairs to 8-ft. well, $6,000.

Ia., Sioux City—Resolution passed authorizing City Clk. to call for bids on constr. of air lift pump'g sys. at Main St. pumping Sta. Est. cost, abt. $40,000.

Kans., Chanute—Plans under way for improv. of waterwks. sys., includ'g elevated tower (250,000-gal. capy.). Est. cost, $42,000. C. Pratt, City Engr.

Kans., Galena—City contemplates bldg. water wks. & filtration plant. Plans now being prepared by Burns & McDonnell, Engrs., Interstate Bldg., Kans. City, Mo. Est. cost abt. $100,000.

Kans., Ogden—$12,000 voted for construc. of water system.

Kans., Osawatomie—Ord. passed for issuance of $20,000 bonds for improv. of water system. J. W. Allard, Clk.

Kans., Sedan—Plans prepared by E. T. Archer & Co., Engrs., 609 New England Bldg., Kans. City, Mo., for extens. of water sys. Abt. $10,000.

Ky., Versailles—Plans & specifications being prepared for new water sys. and street paving. Bids will probably be asked abt. 1st of March. Chas. E. Collins, Drexel Bldg., Philadelphia, Pa., Engr.

Mich., Highland Park—Bids will be asked shortly for construc. of 10,000,000 gal. daily capy. filter plant; also improv. of pump house. Approx. cost, $300,000. L. C. Whitsit, City Engr.

Minn., Brainerd—Bids soon to be asked for construc'g waterwks. & sewerage sys. Approx. cost, $240,000. A. M. Ahlborn, City Clk. K. P. Wolff, 1000 Germania Life Bldg., St. Paul, Consit'g Engr.

Minn., Franklin—Village has voted $60,000 bonds for construc. of water works system. Bids to be asked soon.

Mont., Eureka—Ord. passed for issuance of bonds to amt. to $16,000 for construc. of waterwks. sys.

Mont., Winnett—Plans under way for construc. of reservoir at approx. cost of $15,000.

Neb., Chappell—Bonds to amt. of $10,000 sold. Funds will be used for water works improvement.

Neb., Omaha—Metropolitan Water Bd. contemplates lay'g 4 mi. 8-in. water main to connect Fort Crook to city mains. Est. cost, $60,000.

N. J., Perth Amboy—Plans being prepared for bldg. reservoir, initial capy. 40,000,000-gal.; ultimate capy. 156,000-000-gal., includ'g 10,000 ft. pipe to connect new reservoir with city sys.; also bld. new force main across Raritan River. G. A. Johnson, Consulting Engr.

N. Y., Briarcliff Manor—Bonds to amt. of $16,500 have been sold for water extension.

N. Y., Salamanca—Addition soon to be built to municipal water & light plant on Water St. Approx. cost, $26,000.

N. D., Minot—Bids soon to be asked for lay'g water mains & constr. 3 million gal. rein. conc. reservoir. F. Bass, 244 Plymouth Bldg., Minneapolis, Engr.

O., Hamilton—State Bd. of Health has ordered new receiving well, section line & pumps to be installed. H. R. Garver, Serv. Director.

O., Lorain—City will issue $90,000 bonds for new pumping plant. C. C. Miller, City Engr.

Okla., Guthrie—City contemplates extens. to water sys. as follows: Capy. 3,000,000 gals.; 24-in. rein.-conc. flow line, 3 mi. impound. reservoir, 200,000,000 gals. capy.; filtration plant, new booster pumps. Plans by Benham Engr'g Co., Colcord Bldg., Oklahoma City.

Okla., Woodward—City will soon vote on issuance of $7,000 waterwks. bonds.

Ore., Ontario—Louis C. Kelsey, Hydraulic Engr., Portland, will prepare plans, specifications & detailed ests. of cost of water system.

Pa., Bristol—Plans for chem. apparatus and addn. pumps & extens. to distributing sys. approved by Pa. Dept. of Health, Harrisburg.

Pa., Kingston—Plans approved by Penn. Dept. of Health for construc. of exist'g waterwks. & addn. sources of water supply.

Leading Maker of 3½ and 5-ton Motor Dump Trucks

In position to guarantee immediate delivery, will give *entire* factory discount to best contracting salesmen in few open territories with understanding that one-half of their discount be given to reliable Motor Dealer in each city in which trucks are sold. Proposition will interest you.

Address A1126, care Municipal Engineering, 538 S. Clark Street, Chicago, Ill.

If Your Merchandise is Congested at the Terminals

and you have not sufficient teams or motor trucks to move the goods at once

Buy Them

or hire public ones.

Plan to reach nearby points with motor trucks, teams or waterways—save the railroad terminals. Twenty-five per cent. (25%) of machinery can be delivered in this way, and help break the congestion. No one wants embargoes. If it is decided to reserve certain terminals exclusively for Government materials, do not grumble, but go the extra distance and haul your goods to or from other terminals. Keep your teams and motor trucks going and keep your receiving departments open continuously 24 or 48 hours, if need be, and give the railroads a chance to catch up. Let everybody be prepared some way, somehow, to move their merchandise away from the terminals immediately. Advocate the immediate construction of Permanent Highways connecting our larger cities so you will be in a better position to "clear the way" and help Win the War.

NOTICE TO SUBSCRIBERS

If your copy of *Municipal Engineering* does not arrive promptly, do not assume that it has been lost in transit. With the terrible congested condition of the railroads at this time, delays to mail trains are inevitable. Wait a few days before writing to us—by that time your copy of M. E. will probably be in your hands.

Pa., McKeesport—City planning to improve waterwks. by addn. of 4 filter units (1,000,000-gal. capy.); pumping plant, stand pipe & extens. of water mains. Leo Hudson, Consit. Engr., House Bldg., Pittsburgh.

Pa., Philadelphia—Plans under way for laying water mains in 14 streets in Germantown.

S. C., Columbia—F. C. Wyse, Engr.-Supt. has arranged for fund for improvments to waterwks. Approx. cost abt. $100,000.

Tenn., Knoxville—City will extend water sys. through lower So. Knoxville to Vestal. Est. cost, $53,000, $33,240 for pipe, $2,000 for 25 hydrants, $4,060 for grate valves, etc., & $17,000 for labor.

Tex., Ft. Worth—Plans being prepared by J. H. Gregory, Engr., 170 Bwdy., New York City, for improv'g water filtration plant, addn., rapid filters, new filters, settling basins, mixing chambers, chem. house & aeration chamber. Abt. $85,000.

Va., Norfolk—City has leased docks to Govt., and will furnish water to terminals & naval base, Pine Beach. Plans under way to connect all city lakes, lay larger mains from pump'g sta. to naval base & provide addn. pumping facilities. Walter H. Taylor, Jr., City Engr.; Jos. C. Prince, Chrmn. Water Comm.

Wis., Milwaukee—$30,000 budget for 1918 provides for taking necessary steps to purify water supply.

BRIDGES AND BUILDINGS

Ariz., Prescott—Rein.-conc. brdg. will be built over Verde River at Cottonwood. Est. cost, $40,000.

Cal., Los Angeles—Co. Engr. H. E. Warrington, preparing plans for rein.-conc. brdg. over Verdugo wash at Brand Blvd., 81 ft. long.

Cal, Oakland—Harrington, Howard & Ask, Kans. City, Engrs., have prepared plans which have been accepted for new basoule brdg. across Oakland estuary. Est. cost, $1,800,000.

Cal., San Diego—City contemplates erec. of steel & conc. brdg. across San Diego River at Old Town. Est. cost, $85,000.

Cal., San Jose—$49,200 bonds voted for reconstruct'g brdg. in E. San Jose. G. Walter Hunt, City Engr.

Cal, Red Bluff—Plans being prepared for rein.-conc. brdgs. as follows. 12-span over Thomas Crk., $100,000; 8-span, Deer Crk., $50,000; 4-span, Mill Crk., $40,000; 4-span, Red Bank Crk., $40,000, and several others.

Fla., St. Augustine—City Engr. C. E. Henderson estimates cost of brdg. across North River at $49,016 for struc. with timber piling; $78,720 for struc. with conc. piling. He has also been authorized to secure permission from War Dept. for construct'g brdg. across Matanzas River, St. Augustine to Anastasia Island.

Ga., Atlanta—Four brdgs. planned in following counties: Muscogee, Macon, Lowndes & Thomas; $30,000, $40,000, $20,000 and $30,000. Warren R. Neel, Ch. Engr. State Hwy. Comn.

Ga., Savannah—Central of Georgia Ry. Co. contemplates construc. of draw brdg. across Lazaretto Crk. on Tybee Div. $25,000. C. K. Lawrence, Engr.

Ill., Carlinville—Bd. Supervs., Macoupin Co., contemplate bldg. Death Valley Brdg. Cost abt. $22,000.

Ia., Des Moines—A half-mile viaduct to be built coming year over tracks at E. 6th St., E. Walnut to Allen Sts. Will be rein.-conc., with steel girders. Est. cost, $170,000.

Ia., Marion—Plans under way for 3 rein.-conc. brdgs. on Lincoln Hwy. Bids will be asked in Feb. R. W. Gerhart, Engr. H. R. Churchill Co. Aud. Est., $25,000.

Ia., Traer—Steel brdg. to be constructed across Wolf Crk. north ofooo the Evergreen school, Geneseo, 180 ft. long. Est. cost, $13,800.

Kans., Leavenworth—Plans being prepared for Leavenworth Co. for rebldg. brdg. Abt. $30,000. L. C. Clark, Engr., care T. Watson,Deputy Clk.

La., Shreveport—City planning construc. of brdg. over Cross Bayou, foot of Market St. Waddell & Son, Consult'g Engrs., Kans. City, Mo.

Md., Annapolis—City contemplating constr. of brdg. over Curtis Crk. Est. cost, $25,000.

Mich., Battle Creek—City contemplating erec. of steel & cement brdg. over Kalamazoo River, to replace wooden struc. E. H. Hunt, City Engr., now preparing plans.

Minn., Crookston—Plans being prepared for 6th St. viaduct conc. pier for Gt. Northern Ry. Est. cost, $100,000. A. H. Hogeland, 1222 R. R. Bldg., St. Paul, Chief Engr.

Minn., Duluth—$60,000 available for constr. & repair'g of bridges. L. Ayers, City Engr.

Minn., St. Paul—City Clk. preparing plans for flooring Robert St. brdg. ($5,000); strengthening pier Marshall Av. brdg. ($11,000); walk on Wabasha brdg. ($4,000). City also contemplates bldg. viaduct betw. Maria Ave., 3rd & 4th Sts. & Broadway, 1 mile. Approx. cost, $500,000.

Miss., Vicksburg—$63,000 bonds will be issued for construc. of steel and conc. brdg. over White Creek, Thornberry Hollow, at foot of Pender Hill; also for steel & conc. viaduct across hollow on Hughes Place recently purchased by county.

N. Y., Brooklyn—War Department has approved plans for construc. of brdg. over Sheepshead Bay at Ocean Ave., 30 ft. clear span, 9 ft. high.

N. J., Newark—Plans under way for new brdg., abt. 30 ft. wide, 220 ft. long, over trks. C. R. R. at Port St. Est. cost, $52,000. M. R. Sherrerd, Engr.

O., Akron—Bids soon to be called for by Co. Commrs., Summit Co., for construc. of N. Hill viaduct. Est. cost, $825,000. Chas. J. Costigan, Co. Surveyor.

O., Cleveland—City considering constr. of steel & conc. brdg. over Y. & O. R. R., at Kinsman Rd. & E. 65th St. Abt. $30,000. Robt. Hoffman, City Engr. Plans also being made for repair'g E. 55th St. brdg., steel & wood, stone abutments, over Kingsburg River. Approx. cost, $50,000.

Okla., Ponca City—Bridge to be built across Salt Fork River. $18,000.

Ore., Portland—Plans being prepared for 500-ft. brdg., Hood Co., to be entirely of conc. Est. cost, $35,000 to $40,000. Plans also completed in Feb. for 800-ft. struc. to bebuilt over Deschutes River, to be conc. and have 8 arches.

Pa., Carbondale—City contemplates bldg. steel viaduct over trks. of D. & H. R. R. at Lundaff and Fallbrook Sts. Peck Bros., Engrs., Scranton Life Bldg., Scranton.

Pa., Philadelphia—Plans for brdg. over Delaware River to unite the cities of Philadelphia & Camden, have been tentatively agreed upon by New Jersey & Penn. Brdg. Comns. Cost will be shared equally by both states. Approx. cost, $10,000,000. Plans call for 1,700-ft. span; 152 ft. above level of river at highest point. Storage room (capy. 800,000 cu. ft.) to be built at terminals.

Pa., Pittsburgh—City planning to construct 6 bridges, to replace present structures over Allegheny river, at 6th, 7th, 9th, 16th, 30th and 43rd Sts.

Pa., Reading—City considering constr. of brdg. over Schuylkill River at Bingaman St. Est. cost, $500,000. Chas. Marks, City Clk.

Pa., Scranton—Four bridges will be built on Lackawanna Trail, located near Factoryville, Dalton, LaPlume & Glenburn.

S. C., Columbia—Recommendation has been made to U. S. Dept. of Agriculture by State Hwy. Comn. that 2 steel brdgs. be constructed over Santee River; one at Lanneau's Crossing; the other at Pinckney's Crossing. Approx. cost of each, $173,000 and $154,400 respectively.

Wash., Waterville—City planning to construc. bridge over Foster Crk. Approximate cost, $10,000. R. F. Foster, Co. Engr.

Wis., Fond du Lac—$6,500 included in city budget for brdg. on W. 2nd St.; $8,500 for brdg. on N. Brook St. J. S. McCullough, City Engr. J. F. Hohensee, City Clerk.

1 in 48

Here is what Kansas proposes doing on road construction this year, as reported by W. S. Gearhart, State Highway Engineer:

"Mitchell County will build 11.25 miles of concrete road 16 ft. wide; Douglas County, 18.34 miles of concrete road 18 ft. wide; Cloud County, 8.25 miles of concrete road 16 ft. wida; Shawnee County 10 miles of concrete road 18 ft. wide; Leavenworth County, about 20 miles of concrete road 18 ft. wide; Sedgwick County, 8 miles of concrete road 18 ft wide: Barton County, 27½ miles of brick road 20 ft. wide; Labette County, 44.42 miles of gravel road 17 ft. wide; and Bourbon County, about 35 miles of macadam road 14 it. wide.

"The total value of this work will be approximately **three and one-quarter million** dollars. All of this work has been financed and is in additson to about **seven million** dollars which will be available for the construction and maintenance of township and county roads and bridges."

"WHY" Genuine Berea Sandstone Curbing

IS SO EXTENSIVELY USED. *BECAUSE:*

It is *Nature's* formation. It is durable—lasts generations. It adds beauty to your streets. It does not disintegrate or decay. It defies the elements. It has character. It is *dependable*. It is sold at a reasonable price.

THE CLEVELAND STONE CO.

PRODUCERS

MAIN OFFICES: Leader-News Building, CLEVELAND, OHIO.
WESTERN OFFICES: 522 Marquette Building, CHICAGO, ILL.

ENGINEERS' AND CONTRACTORS' DIRECTORY

JOHN W. ALVORD :: CHAS. B. BURDICK

Consulting Engineers

Water Supply Sewerage Water Works

HARTFORD BUILDING, CHICAGO, ILLINOIS.

DOW & SMITH

CHEMICAL ENGINEERS

CONSULTING PAVING ENGINEERS

A. W. DOW, Ph. B. Mem. Amer. Inst. Ch. Engrs.
F. P. SMITH, Ph. B. Mem. Amer. Soc. Civil Engrs.

Asphalt, Ritumens, Paving, Hydraulic Cement, Engineering Materials.

131-3 E. 23rd Street NEW YORK CITY

MASON L. BROWN & SON

CIVIL ENGINEERS and LANDSCAPE GARDENERS

820 to 824 Chamber of Commerce, DETROIT, MICH.

Surveys, Plans, Specifications, Estimates, Superintendence, FOR { Electric Railways, Sewerage, Water Supply, Paving, Macadamizing, Parks, Cemeteries, Development of Suburban Properties.

WALTER H. FLOOD

CHEMICAL ENGINEER

PAVING AND ENGINEERING MATERIALS

Tests Inspections Specifications Reports

3725 Langley Avenue CHICAGO

CHAS. BROSSMAN

CONSULTING ENGINEER

Water Supply. Sewerage and Disposal. Lighting Plants—Supervision of Construction and Reduction in Operating Cost. Appraisals—Expert Testimony.

Merchants Bank Building INDIANAPOLIS, IND.

J. W. HOWARD, Consulting Engineer

PAVEMENTS AND ROADS

Laboratory Analyses and Tests of all Materials

Construction Inspected. 29 Years Experience.

1 Broadway, NEW YORK.

CHICAGO PAVING LABORATORY

LESTER KIRSCHBRAUN, Ch. E., Director

CONSULTING and TESTING ENGINEERS
PAVEMENTS and PAVING MATERIALS

160 N. FIFTH AVE., CHICAGO

Reports, Specifications, Plant, Street and Laboratory Inspection.

ROBERT W. HUNT. JNO. J. CONE. JAS. C. HALLSTED. D. W. McNAUGHER.

ROBERT W. HUNT & CO., Engineers

CEMENT INSPECTION

Inspection Buildings, Bridges, Etc. Paving Brick and Creosoted Blocks. Chemical and Physical Testing.

Chicago New York Pittsburgh St. Louis London
Montreal San Francisco Toronto Mexico City Seattle

CITY-WASTES DISPOSAL CO.

(Organized from Staff of Col. Geo. E. Waring, Jr.)

Consulting Engineers. Specialists in Drainage, Sewerage and Sewage Disposal. Preliminary Investigations and Estimates, Surveys, Plans and Supervision. Sanitary Examinations and Reports.

45 Seventh Avenue. NEW YORK.

SAM. L. JONES, Consulting Engineer

PAVEMENTS and ROADS

Specifications, Estimates and Cost Systems

807 Second Nat'l Bank Bldg. CINCINNATI, OHIO

B. H. COLBY

M. Am. Soc. C. E.

CIVIL AND CONSULTING ENGINEER

Plans, Specifications, Estimates and Superintendence for Sewerage Systems, Sewage Disposal, Water Supply, Water Works, Dams, Reservoirs, Street Paving and County Roads, Landscape Work for Parks and Cemeteries, Topographical Surveys, Examinations and Reports.

812-813 Security Building, ST. LOUIS, MO.

ALEXANDER POTTER, C. E.

HYDRAULIC ENGINEER AND SANITARY EXPERT

50 Church St., New York City.

Sewerage and Sewage Disposal, Water Supply and Purification, Water and Electric Power.

Valuations of Existing Plants where MUNICIPAL OWNERSHIP is Contemplated — Expert Testimony — Plans and Estimates.

CHARLES E. COLLINS

Mem. Am. Soc. C. E.

CONSULTING ENGINEER

Water Supply, Water Power, Sewerage, Sewage Disposal, Supervision of Construction and Operation, Valuations.

Drexel Building, Philadelphia, Pa.

W. S. SHIELDS

CONSULTING ENGINEER

Municipal Improvements. Water Supplies and Water Works Systems. Sewers and Sewage Disposal. Pavements and Roads.

Hartford Building. CHICAGO, ILL.

Testing, Consultation, Bitumens, Paving.
Inspection, Specifications, Asphalts, Road Oils.

ISAAC VAN TRUMP

ENGINEERING CHEMIST

2337 South Paulina Street. CHICAGO, ILL.

SULLIVAN, LONG & HAGERTY

GENERAL CONTRACTORS

Builders of Sewer Systems and Water Works Plants.

Home Office, BESSEMER, ALA.

UVALDE

ASPHALT PAVING COMPANY

1 Broadway, NEW YORK.

CHLORIDE OF LIME

FOR PURIFYING WATER

PENNSYLVANIA SALT MANUFACTURING CO.

115 Chestnut Street, PHILADELPHIA, PA.

Do Business by Mail

Start with accurate lists of names we furnish—build solidly. Choose from the following or any others desired.

Apron Mfrs.	Wealthy Men
Cheese Box Mfrs.	Ice Mfrs.
Shoe Retailers	Doctors
Tin Can Mfrs.	Axle Grease Mfrs.
Druggists	Railroad Employees
Auto Owners	Contractors

Our complete book of mailing statistics on 7000 classes of prospective customers free.

Ross-Gould, 826-R Olive Street, St. Louis.

ROSS-GOULD
Mailing Lists St. Louis

Littleford Tar Heaters

The Proof of the Heater is in the Heating

Built in sizes ranging from 50 to 900 gallons.

Especially adapted for road and street construction and maintenance work.

Write for Catalog.

LITTLEFORD BROS., 460 E. Pearl St., Cincinnati, Ohio.

Municipal Bond Advertising

The success of a sale of state, county or municipal bonds depends entirely upon the publicity given it.

The majority of all municipal issues do not reach the investor directly, but pass through the hands of a dealer who specializes in their purchase and sale.

There are several hundred municipal bond dealers located throughout the country. Many of these bond firms buy a great variety of issues from counties, cities and villages located in the East and West, North and South.

Since a really successful sale will only result from competitive bidding participated in by many different bidders, it is clear that a municipality should advertise its bond offering in a paper specializing in bond news and read by all the dealers interested in this news.

The Bond Buyer, issued daily and weekly, is just such a medium! It never speaks of anything but municipal bonds, and, after twenty-five years of this specilization, it has come to be accepted by legislators and public officials as **"The Authority on Municipal Bonds."**

There is a service rendered by **The Bond Buyer** that every county, city and town treasurer should know about. **If you have bonds to sell,** address

The Bond Buyer

The Authority on Municipal Bonds

25 West Broadway
NEW YORK, N. Y.

PROPOSAL ADVERTISEMENTS

CLASSIFIED ADVERTISEMENTS PAY

If you are seeking employment, have second-hand machinery for sale, want to purchase machinery or supplies, want competent men to fill responsible positions, or have proposals to advertise, an ad. in these columns will put you in touch with responsible parties who can supply your wants.

RATES:

Want Ads. 1½ cents per word.
For Sale Ads. 25 cents per line.
Proposal Ads. 15 cents per line.
Minimum, 50 cents.

Rates on Display Ads. on Application.

Engineering Publishing Co.
INDIANAPOLIS, IND.

FOR SALE

PIERCE-ARROW 5-ton, 3-yard Steel Dump Truck with hydraulic hoist. Condition guaranteed

Price, $2,800.

LYONS-BARTON MOTOR CAR CO.

828-832 HOWARD AVE.

NEW ORLEANS, LA.

Bids received until February 5, 1918.

SEWERAGE SYSTEM.

Phillipsburg, New Jersey.

Sealed proposals for the construction of the sewerage system and disposal plant will be received by the Board of Commissioners of the Town of Phillipsburg, New Jersey, until 2 p. m., Tuesday, February 5, 1918.

The work consists of:

Contract I. Treatment Plant.

Two fine screens, each 2,000,000 gallons capacity per 24 hours substructure, valves, gates, etc., or any other type of sewage purification works.

Automatic sterilizing apparatus, complete.

Contract II. Cast Iron Outfall.

800 ft. cast iron pipe, 24-in. diam.
4 manholes.

Contract III. Collecting Trunk Sewer.

1287 ft. 20-in. vitrified pipe sewer.
3014 ft. 24-in. vitrified pipe sewer.
351 ft. 27-in. vitrified pipe sewer.
24 manholes.

Contract IV. High Level Interceptor Sewer.

370 ft. 10-in. vitrified pipe sewer.
2383 ft. 12-in. vitrified pipe sewer.
1092 ft. 18-in. cast iron sewer.
1596 ft. 18-in. vitrified pipe sewer.
26 manholes.

Contract V. South Main St. Storm Sewer.

171 ft. 18-in. vitrified pipe sewer.
963 ft. 22-in. vitrified pipe sewer.
409 ft. 24-in. vitrified pipe sewer.
8 manholes.

A certified check drawn to the order of James L. Lomerson, Treasurer, in the sum of One Thousand Dollars ($1,000) must accompany each proposal, to be held as liquidated damages.

Plans, profiles, specifications, blank forms of proposals and all other information may be obtained at the office of the Town Engineer.

The Board reserves the right to reject any part of any proposal or any or all proposals.

ROBERT P. HOWELL,
Town Engineer and Commissioner of Street and Public Improvements,
98 South Main St.,
Phillipsburg, N. J.

Dated, January 2, 1918.

Bids received until February 5, 1918.

WATER WORKS SUPPLIES.

Toledo, Ohio.

Sealed proposals will be received by the Commissioner of Purchases and Supplies of the City of Toledo, Ohio, at 340 Valentine Building, Toledo, Ohio, until 12:00 noon, standard time, on Tuesday, February 5, 1918, and then publicly opened and read, for the furnishing of materials and supplies required by the Division of Water, Department of Public Service, City of Toledo, Ohio, during the year 1918, of the character and in the quantities below stated:

800 tons hydrated lime.
700 tons sulphate of iron.
750 tons sulphate of alumina.
7 tons liquid chloride.
500 tons cast iron pipe.
10 tons cast iron specials.
2658 water meters.
500—⅝ in. corporation cocks.
500—¾ in. curb cocks.
40 tons pig lead.
36 tons ¾ in. lead pipe.
9 tons 1 in. lead pipe.
2000 cast iron curb boxes.

Copies of the specifications, proposal forms, forms of bonds and contracts may be secured from the Commissioner of Purchases and Supplies, 340 Valentine Building, Toledo, Ohio.

Each bid must be made upon the proposal forms prepared and furnished by the City of Toledo, and must be accompanied by such specifications and drawings prepared by the bidder as will clearly show the nature of the material and equipment upon which proposals are based.

Each bidder must file with his proposal a certified check drawn to the Commissioner of Purchases and Supplies, City of Toledo, Ohio, in a sum equal to 10% of the bid price of the materials proposed to be furnished, said check to guarantee the execution and performance of a contract and its proper security, and to be forfeited to the City of Toledo in case bidder fails to enter into a contract.

The Commissioner of Purchases and Supplies reserves the right to reject any and all bids or to accept any bid which he may deem advantageous to the City of Toledo, Ohio.

By direction of the Commissioner of Purchases and Supplies.

City of Toledo, Ohio.

Bids received until February 4, 1918.

WATER WORKS SYSTEM.

Wilton, N. Dakota.

Sealed bids for the construction of a water works system for the City of Wilton, North Dakota, will be received by the City Council of said City until 8 o'clock p. m., February 4, 1918. Each bidder is required to state the rate of interest the improvement warrants shall bear (not exceeding seven (7) per cent. per annum), which are to be received and accepted by them at par in payment for the work. All of said work to be done according to the plans and specifications, which are on file in the office of the City Auditor.

The following approximate quantities are given for the guidance of the bidder:

50,000 gallon steel tank on a 125-foot steel tower.

1,552 lineal feet of Class B 8-inch cast iron water main.

11,344 lineal feet of Class B 6-inch cast iron water main.

25 hydrants.
2 four-inch wells.
1 pump house.
2 motor driven power heads for wells.
1 heating system.

Bids will be received providing for the completion of the different parts of the work on the following dates:

For completion of the wells, April 15, 1918.

For installation of pumping machinery, May 15, 1918.

For completion of pump house, May 15, 1918.

For installation of heating system, June 1, 1918.

For completion of tower and tank, June 1, 1918.

For completion of water mains, October 1, 1918.

Bids will be received on the above named units of the system separately and the City Council reserves the right to award any one of the units or all of them to the same contractor as the best interests of the City may appear.

Each proposal must be accompanied by a certified check in the sum of Five Hundred ($500) Dollars, made payable to the order of Robert Cotton, Mayor, as a guarantee that the bidder will enter into a contract for the performance of such work.

Each proposal must also be accompanied by a bidder's bond running to the City of Wilton in a sum equal to the full amount of bid as provided in Section 3707, Compiled Laws of North Dakota, 1913.

The right is reserved to reject any or all bids.

J. J. Schmid,
City Auditor.

Bids received until February 6, 1918.

GARBAGE DISPOSAL, ETC.

Ardmore, Pa.

Bids will be received at the office of the Commissioners of Lower Merion Township, Ardmore, Penn., till noon on February 6, 1918, for the collection and disposal of garbage from two of the garbage districts.

Disposal of the garbage will be by incineration or feeding to swine.

Plan, specifications and all other details may be inspected at the above mentioned office.

The Commissioners reserve the right to reject any or all bids.

HENRY DELAPLAINE,
Chairman.

ROBLEY A. WARNER,
Superintendent.

Bids received until February 4, 1918.

SEWER SYSTEM.

Wilton, North Dakota,

Sealed bids for the construction of a sewer system in Sewer Improvement District Number One, City of Wilton, North Dakota, will be received by the City Council of said city until 8 o'clock p. m., February 4, 1918. Each bidder is required to state the rate of interest the improvement warrants shall bear (not exceeding seven (7) per cent. per annum), which are to be received and accepted by them at par in payment for the work. All of said work to be done according to the plans and specifications, which are on file in the office of the City Auditor.

The following approximate quantities are given for the guidance of the bidder:

2,005 lineal feet of 12-inch vitrified sewer pipe.

4,747 lineal feet of 10-inch vitrified sewer pipe.

4,506 lineal feet of 8-inch vitrified sewer pipe.

31 manholes.
1 lamphole.
500 feet of open ditch at outlet.

Bids will be received providing for the completion of the work September 1, 1918.

Each proposal must be accompanied by a certified check in the sum of Five Hundred ($500) Dollars, payable to the order of Robert Cotton, Mayor of the City of Wilton, as a guarantee that the bidder

will enter into a contract for the performance of such work.

Each proposal must also be accompanied by a bidder's bond running to the City of Wilton, in a sum equal to the full amount bid as provided in Section 3707, Compiled Laws of North Dakota, 1913.

The right is reserved to reject any or all bids.

J. J. SCHMID,
City Auditor.

Bids received until February 13, 1918.

NOTICE TO CONTRACTORS.

Pine City, Pine County, Minn.

Construction of Minnesota Project No. 1, Pine County, including all grading, surfacing, bridges and culverts on 50 miles of state road.

Sealed proposals will be received at the office of the County Auditor of Pine County at Pine City, Minn., until 1:30 o'clock p. m., February 13, 1918, for the construction of all bridges and culverts and the furnishing of all surfacing and portable culvert material on Minnesota Project No. 1, involving the following items:

BRIDGES.

No. 2023—18-ft. slab span.
No. 2025—18-ft. slab span.
No. 2026—400-ft. (twenty 20-ft. slabs on concrete piles).
No. 2683—30-ft. deck girder.
No. 2771—18-ft. slab span.
No. 2772—30-ft. beam span.

REINFORCED CONCRETE CULVERTS.

One—W104——Length 25 ft.
One—W 64—Length 25 ft.
One—W 66—Length 36 ft.

PORTABLE CULVERT MATERIAL.

Section Concrete Culverts.

Size.	Quantity.
12-in.	1,997 ft.
15-in.	188 ft.
18-in.	400 ft.
24-in.	544 ft.
36-in.	74 ft.

SURFACING MATERIAL.

Quantity.	Class.
60,941 cu. yds.	Gravel

On the above work separate bids will be received as follows:

For each of the bridges singly, and for any group of bridges; for each of the culverts and for all of the culverts as a group; for all or any part of the portable culvert material; and for all or any part of the gravel surfacing material.

Sealed proposals will also be received by the County Board of Pine County at the above named place until 11 a. m., February 14, 1918, for the grading and surfacing of Minnesota Project No. 1, Pine County, involving the following items:

Clearing 31.9 acres.
Grubbing, 45.0 acres.
Excavation, 173,646 cu. yds.
Hand ditching, 4,098 cu. yds.
Reshaping crown of road, 76,700 lineal feet.
Guard rail, 4,990 lineal feet.
Installing portable sectional concrete culverts as follows:

12-in.—1,997 feet.
15-in.— 188 feet.
18-in.— 400 feet.
24-in.— 544 feet.
36-in.— 74 feet.

Gravel surfacing, 60,941 cu. yds.

The grading and surfacing on the 50 miles of state road covered by this project has been divided into ten jobs of five miles each and separate bids will be received on each of the ten jobs for the grading and work incidental thereto, or for the grading and graveling and work incidental to each.

Plans and specifications may be examined at the office of the County Auditor, Pine City, Minn., or at the office of the Minnesota Highway Department, 300 Shubert building, at St. Paul. Blue prints of plans may be obtained from the Minnesota Highway Department at the bidder's expense.

The right is reserved by the County Board to reject any or all bids and to waive any defects. Bids must be accompanied by a certified check, payable to the County Treasurer, for at least 5 per cent. of the amount of the proposal.

W. H. HAMLIN,
County Auditor, Pine City, Minn.
(County Auditor's Seal.)

MISCELLANEOUS WANTS

WANTED—Salesmen in all parts of the country to handle as a sideline on a commission basis a sand testing device of pocket size. Device has proved its worth and is of very moderate price. A liberal commission on all sales. Address inquiries to "Sand Tester," care of Municipal Engineering, 538 S. Clark St., Chicago, Ill.

WANTED—Salesmen who know the contracting game and who sell contractors in other lines to handle a line of asphalt surface heaters, tool furnaces, blow torches and other asphalt tools on a commission basis, in conjunction with other lines not competing with these. Some very desirable territories still open. Address inquiries to "Asphalt," care of Municipal Engineering, 538 S. Clark St., Chicago, Ill.

WANTED—Contracting salesmen in middle west to handle a high grade line of popular and economical locomotives for contractors' use; also portable track and cars. Liberal commission on all sales. Address inquiries to "Locomotives," care of Municipal Engineeering, 538 S. Clark St., Chicago, Ill.

WANTED—Salesmen in touch with concreting contractors and familiar with the mixing and placing of concrete to handle a line of pneumatic concrete mixing and conveying apparatus on a commission basis. This system is comparatively new but is thoroughly tested out and approved by leading engineers and contractors. It is applicable to both heavy mass construction and thin impervious construction. Especially appropriate for lining tunnels and concreting bridge piers, abutments, retaining walls, etc., particularly where access to forms is difficult. An unusually attractive proposition. Address inquiries to "Pneumatic," care of Municipal Engineering, 538 S. Clark St., Chicago, Ill.

WANTED—Salesmen and dealers to handle a full line of engineers' surveying and office instruments on a commission basis as a sideline. This is a good line of instruments approved by practicing engineers and engineering colleges. Salesmen given personal co-operation in all particulars. Address inquiries to "Instruments," care of Municipal Engineering, 538 S. Clark St., Chicago, Ill.

WANTED—Salesmen to handle Ford attachment in the contracting field. This attachment is for use in connection with a Ford chassis and is easily fitted by any ordinary mechanic. The commission proposition is liberal. Much good territory is still open. Prompt deliveries are guaranteed. Address "Ford," care of Municipal Engineering, 538 S. Clark St., Chicago, Ill.

WANTED—Salesmen in touch with the contracting field who are in a position to sell 3½ to 5-ton motor trucks on a commission basis in conjunction with non-competitive lines. Immediate deliveries. Address inquiries to "Truck," care of Municipal Engineering, 538 S. Clark St., Chicago, Ill.

WANTED—Contracting salesmen to handle an A1 line of 1-ton motor trucks suitable for use of contractors and city public works departments on liberal commission basis. Immediate deliveries guaranteed. Address inquiries to "One-Ton," care of Municipal Engineering, 538 S. Clark St., Chicago, Ill.

WANTED—Salesmen and agents to handle a line of road rollers with scarifier attachment. A new thing that has made good. Good territory available and commissions are right. Address "Scarifier," care of Municipal Engineering, 538 S. Clark St., Chicago, Ill.

WANTED—Salesmen handling contracting machinery and other non-competitive lines on a commission basis to handle a line of road machinery, including road rollers, graders, etc. Address inquiries to "Road Machinery," care of Municipal Engineering, 538 S. Clark St., Chicago, Ill.

Some materials and labor now used for unnecessary things may be released for the use of the government in winning the war

That does not mean the crippling of business. Business as a whole should and will be far greater than ever before because of the enormous buying by the Government and our allies.

Good Business Now!

WALL STREET believes firmly that a period of unprecedented world-wide business activity will immediately follow peace. This is because everywhere the supply of commodities is below the demand. How long it will take to catch up no one knows; it may be a matter of three or five years or more. Perfect your organization *now! Be Ready!* But you can do a *big business now* (right in your line) if you follow up all the Contracts Awarded and as given each day in the Daily Advance Contract News Bulletins of *Municipal Engineering.*

We are publishing (every day) *more* Contracts Awarded than we published for the same days of 1916 or 1915.

One Man *With* a Marchant

CAN DO THE WORK OF FOUR OR FIVE MEN *WITHOUT* IT.

The **Marchant** adds, divides, multiplies, subtracts, extracts square and cube root in about 25 per cent of the time used in "hand figuring."

Give your men's brains a chance to concentrate on **the work a machine cannot do.** Relieve them of the work **that a machine can do more quickly and accurately.** Get a **Marchant** to do the machine work. It will pay.

Free Trial Marchant Calculator

We will put a **Marchant** on your work, *to sell* itself. Use it for figuring areas, volumes, weights—figuring all extensions and carrying the totals. Use it for making up the payroll, checking bills—for reducing levels, computing stresses *for all of the endless calculating that every engineer and contractor has to do.*

For full details of our free trial offer, mail this coupon.

Marchant Calculating Machine Co.

OAKLAND, CALIFORNIA.

Chicago Branch Office: 359 Railway Exchange Bldg.

MARCHANT CALCULATING MACHINE CO.
DEPT. M. E. OAKLAND, CALIF.

Please send me details regarding the Marchant Calculating Machine as applied to calculations necessary in Contracting Work.

Name _____

Firm _____

Address _____

Business _____

M. J. BANNON, Pres. & Gen. Mgr. P. BANNON, Jr., V. P. & Treas.

P. BANNON PIPE CO.

ESTABLISHED 1852. INCORPORATED

Manufacturers of

Bannon's Patent Lidded Pipe for Steam Conduits
Sewer and Culvert Pipe
Wall Coping **Fire Brick**
Flue Lining **Fire Clay**
Grate Tile **Chimney Tops**
Drain Tile

Offices: 528 West Jefferson Street

Works: 13th and Breckenridge Sts. **Louisville, Ky.**

Sewer Pipe
Steam Conduits
Fire Brick
Book Tile

ASTRID ROSING INC.

Harris Trust Bldg. **CHICAGO.**

MURPHYSBORO PAVING BRICK COMPANY

Equal to the Best **"EGYPTIAN" BLOCK** **Surpassed by None**

MURPHYSBORO, ILLS.

PROMPT DELIVERIES. **LET US QUOTE YOU PRICES.**

SLUICE GATES
Shear, Flap and Butterfly Valves
FLEXIBLE JOINTS
COLDWELL-WILCOX CO.

South Water Street **NEWBURGH, N. Y.**

BEST EXTENSIBLE TRENCHING BRACE MADE

KALAMAZOO F'DRY & MACHINE CO. MICHIGAN

594 EAST MAIN STREET.

WM. E. DEE CLAY MFG. CO.

Proprietors of MECCA CLAY WORKS

MANUFACTURERS OF

STANDARD AND DOUBLE STRENGTH

Sewer Pipe, Drain Tile, Culvert Pipe, Well Tubing, Flue Lining, Wall Coping and Fire Brick.

WORKS { Mecca, Parke County, Ind., on C. & E. I. R. R.
Newport, Vermillion County, Ind., on C. & E. I. R. R.

Chicago Office, 30 N. La Salle St.

THE CUMMER ROAD ASPHALT PLANT

Three Sizes. Three Units. Capacity 750, 1250 and 1800 Square Yards 2-inch Top or Macadam Daily

THE CUMMER ONE-CAR ASPHALT PLANT

Capacity 2000 Square Yards 2-inch Top or Macadam Daily

THE F. D. CUMMER & SON COMPANY, CLEVELAND, OHIO

Plants in Stock Can Show Them in Operation

New Automatic Cement Tester

Gold Medal Jamestown Tercentennial Exposition, 1907.

Manufacturers of Cement, Concrete, Brick and Road Material Testing Machines and All Auxiliary Laboratory Apparatus

Tinius Olsen Testing Machine Co.

500 North Twelfth Street PHILADELPHIA, PA.

SEWER PIPE

Segment Sewer Block, Drain Tile, Hollow Building Block, Flue Lining, Wall Coping, Etc.

LEWIS McNUTT

28 South Walnut St. BRAZIL, INDIANA.

Our Special Feature is anything in the Clay Goods Line in mixed or straight cars.

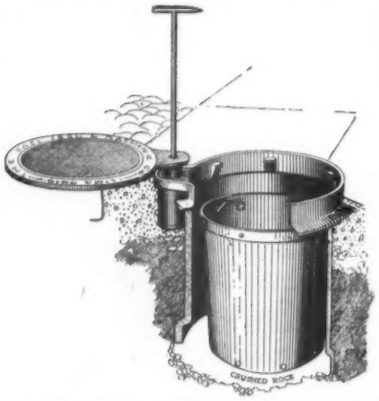
Clay Products

SEWER PIPE OF QUALITY

Made of a SUPERIOR QUALITY of FIRE CLAY in the Finest Plant in the West.

The pipe that WON THE TEST for crushing strength before the Louisville Sewer Commission, showing an average CRUSHING STRENGTH OF 43 PER CENT HIGHER than competitors' samples. Just a little better than the rest. Write us today for particulars.

CANNELTON SEWER PIPE CO. . . Cannelton, Ind.



RANSEHOUSEN

Pivot Lock Manhole Covers

Positive lock and they are *always* locked because you *can't* take out the 3-foot iron key until they are locked. Made to fit *any* manhole or coal hole opening. Mechanism is simple and absolutely protected from moisture or dust. Specify **"Ransehousen"** if you want to side-step "open manhole" troubles. Particulars on request.

The East Iron & Machine Co., Lima, Ohio.

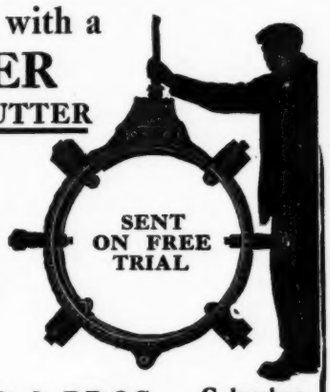
Makers of Merriman Steam Melting Asphalt Plants.

Holzbog Sanitary Garbage Carts are smell-tight and can't leak.

Send for Catalog if interested.

GEO. H. HOLZBOG & BRO.
Manufacturers of Sanitary Carts, Ambulances and Litters
JEFFERSONVILLE, IND.

Cut that *Next* Job with a
STRICKLER
RATCHET PIPE CUTTER



You will be surprised at the speed. At the Smooth, Clean, Square Cut. No filing or reaming after the Automatic Strickler has done its work. As smooth on 30″ pipe as on ⅜″. Each size cuts a range of pipe sizes.

Just tell us the size of Pipe you are going to cut. No obligation on your part.

W. W. STRICKLER & BROS., Columbus, Ohio.

STEWART SEWER CLEANING MACHINE

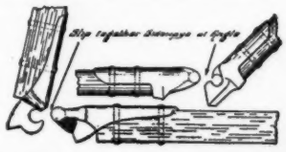
Water Cleaning System if you wish it, or Drag Bucket type.

Also have TURBINE SEWER CLEANING MACHINE at Low Price.

WE WILL PAY FREIGHT AND CHARGE TO BILL.

We Ship Rods for Trial—who else will do this?

We also make a Rod that will float. Also Rods with wheels for conduit work.



SEWER AND CONDUIT RODS

No Deep Shoulder Cut for Couplings—Rods retain full size and strength

Investigate our JUMBO ROD

W. H. STEWART

1614 Locust Street - - ST. LOUIS, MO.
129 George Street - - - BOSTON, MASS.

CANADA FACTORY, WALKERVILLE, ONT.
THEREFORE NO DUTY FOR PURCHASER TO PAY
PACIFIC COAST DELIVERIES MADE FROM SAN FRANCISCO.

WM. E. DEE COMPANY

30 North La Salle Street. CHICAGO, ILL.

WE MANUFACTURE

D & D Safety Cover
GUARANTEED NOT TO RATTLE OR DISH

Full Line of MANHOLE and CATCH BASIN COVERS of all Kinds.

WRITE FOR OUR PRICES

ACME

Manholes, Catch Basins, Inlet Basins, Park Basins (All Styles)

REGULAR AND SPECIAL GRATES OR STRAINERS FOR SEWER PIPE.

BUILDING COLUMNS OF ALL DESCRIPTIONS.

SEND US YOUR SPECIFICATIONS

MADISON FOUNDRY CO.
927 Addison Road, CLEVELAND, OHIO.

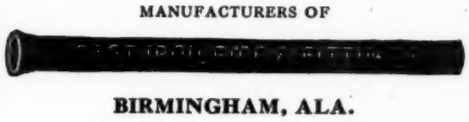
Advertise Your Proposals

Give widest possible publicity to your Proposal Advertising. Your advertisement in *Municipal Engineering* will carry your message to leading and well-rated contractors specializing in the construction of Streets, Roads, Sewers, Bridges, Water Works Extension, Etc.

Advertise Your Proposals

American Cast Iron Pipe Company

MANUFACTURERS OF



BIRMINGHAM, ALA.

SALES OFFICES:

Birmingham, Ala.	Box 908.
Columbus, Ohio	607 New Hayden Building.
Minneapolis, Minn.	712 Plymouth Building.
New York City	No. 1 Broadway.
Chicago, Ill.	512 First National Bank Building.
Dallas, Texas	1217 Praetorian Building.
Kansas City, Mo.	716 Scarritt Building.
San Francisco, Cal.	711 Balboa Building.

INDEX TO ADVERTISEMENTS

	Page
Acason Motor Truck Co., Detroit, Mich	37
Acme Motor Truck Co., Cadillac, Mich	
Alger Supply Co., Chicago, Ill	13
Alvord, John W., & Charles B. Burdick, Chicago, Ill	59
American Cast Iron Pipe Co., Birmingham, Ala	65
American Motor Truck Co., Detroit, Mich	42
American Telephone and Telegraph Co., New York, N. Y.	
Armco Iron Culvert and Flume Mfrs. Association, Cincinnati, O.	49
Atlas Portland Cement Co., New York, N. Y	49
Austin Manufacturing Co., Chicago, Ill	4
Bannon Pipe Co., P., Louisville, Ky	63
Barrett Co., The, New York, N. Y	2-45
Bell Locomotive Works, Inc., New York, N. Y	48
Bond Buyer, The, New York, N. Y	60
Brossmann, Chas., Indianapolis, Ind	59
Brown, Mason L., & Son, Detroit, Mich	59
Buffalo Springfield Roller Co., Springfield, O	7
Cannelton Sewer Pipe Co., Cannelton, Ind	64
Chicago Paving Laboratory, Chicago, Ill	59
City Wastes Disposal Co., New York, N. Y	59
Cleveland Stone Co., The, Cleveland, Ohio	58
Colby, B. H., St. Louis, Mo	59
Coldwell-Wilcox Co., Newburgh, N. Y	63
Collins, Charles E., Philadelphia, Pa	59
Columbia Motor Truck and Trailer Co., Pontiac, Mich	inside back cover
Contractors Equipment	64-65
Couple-Gear Freight Wheel Co., Grand Rapids, Mich	51
Cummer & Son Co, The F. D., Cleveland, O	64
Cutter Co., Geo., South Bend, Ind	15
Dee Clay Mfg. Co., W. E., Chicago, Ill	64
Dee, Wm. E., Co., Chicago, Ill	65
Detroit Truck Co., Detroit, Mich	38
Dow & Smith, New York, N. Y	59
Dunn Wire-Cut-Lug Brick Co., Conneaut, O	20
Duplex Truck Co., Lansing, Mich	37
DuPont DeNemours & Co., Wilmington, Del	12
East Iron and Machine Co., The, Lima, Ohio	64
Engineers and Contractors	59-60
Federal Motor Truck Co., Detroit, Mich	44
Flood, Walter H., Chicago, Ill	59
Ford Meter Box Co., Wabash, Ind	12
Garford Motor Truck Co., Lima, Ohio	23
General Motors Truck Co., Pontiac, Mich	24
Gramm-Bernstein Motor Truck Co., Lima, Ohio	28
Hayward & Co., S. F., New York, N. Y	51
Heltzel Steel Form and Iron Co., Warren, O	49
Hendricks Co., S. E., Inc., New York, N. Y	56
Highway Economist	17, 18, 19, 20
Holzbog & Bro., Geo. H., Jeffersonville, Ind	65
Howard, J. W., New York, N. Y	59
Hunt & Co., Robert W., Chicago, Ill	59
Hurlburt Motor Truck Co., New York, N. Y	43
International Motor Company, New York, N. Y	22
Jennison-Wright Co., Toledo, Ohio	
Jones, Sam L., Cincinnati, Ohio	59
Kalamazoo Foundry and Machine Co., Kalamazoo, Mich	63
Kissel Motor Car Co., Hartford, Wis	41
Koehring Machine Co	16
Kolesch & Co., New York, N. Y	46
Lewis-Hall Iron Works, Detroit, Mich	39
Littleford Bros., Cincinnati, Ohio	60
Lufkin Rule Co., The, Saginaw, Mich	50
MacRae's Blue Book Co., Chicago, Ill	54
Madison Foundry Co., Cleveland, Ohio	65
Marchant Calculating Machine Co., Oakland, Cal	63
Master Trucks, Inc., Chicago, Ill	30
Mathews Gravity Carrier Co., Ellwood City, Pa	15
McNutt, Lewis, Brazil, Ind	64
Medal Paving Brick Co., Cleveland, O	19
Metropolitan Paving Brick Co., The, Canton, O	18
Motor Truck Section	21-44
Murphysboro Paving Brick Co., Murphysboro, Ill	63
National Fire Proofing Co., Pittsburgh, Pa	inside front cover
Ohio Quarries Co., The, Cleveland, Ohio	14
Olsen Testing Machine Co., Philadelphia, Pa	64
Pawling & Harnischfeger Co., Milwaukee, Wis	13
Pennsylvania Salt Manufacturing Co., Philadelphia, Pa	60
Pierce-Arrow Motor Car Co	32, 33
Pioneer Asphalt Co., Lawrenceville, Ill	49
Pneumatic Concrete Machinery Co., New York, N. Y	9
Potter, Alexander, New York, N. Y	59
Proposal Advertisements	61-62
Republic Creosoting Co., Indianapolis, Ind	5
Rosing, A. S., Chicago, Ill	63
Ross-Gould, St. Louis, Mo	60
Service Motor Truck Co., Wabash, Ind	26
Schacht Motor Truck Co., Cincinnati, Ohio	36
Shields, W. S., Chicago, Ill	59
Signal Motor Truck Co., Detroit, Mich	40
South Bend Motor Car Works, South Bend, Ind	47
Southern Clay Mfg. Co., Chattanooga, Tenn	19
Springfield Paving Brick Co., Springfield, Ill	19
Standard Oil Co. (Indiana), Chicago, Ill	11
Stewart, W. H., St. Louis, Mo	65
Storms Manufacturing Co., Chicago, Ill	15
Strickler & Bros., W. W., Columbus, Ohio	65
Sullivan, Long & Hagerty, Bessemer, Ala	60
Trussed Concrete Steel Co., Youngstown, Ohio	14
United Motors Co., Grand Rapids, Mich	front cover
United States Motor Truck Co., The, Cincinnati, Ohio	34
Uvalde Asphalt Paving Co., New York, N. Y	60
Van Trump, Isaac, Chicago, Ill	60
Warren Brothers Company, Boston, Mass	1
Warren Foundry and Machine Co., New York, N. Y	51
Wilson Co., J. C., Detroit, Mich	back cover
Wisconsin Motor Mfg. Co., Milwaukee, Wis	37

"KEEP THE HOME FIRES BURNING"

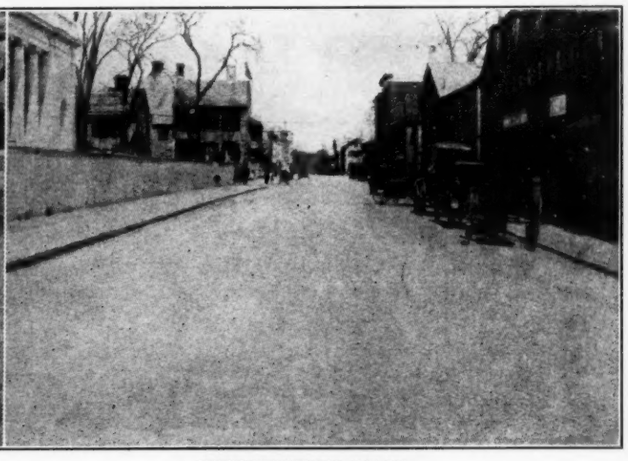
Save and spend wisely—thrift or luxury in excess may become a National weakness—for never in the Nation's History was it so vital to have Good Roads for transportation.

It is necessary to Keep up Public Improvement—it would be false economy not to.

Have your streets paved with a substantial construction that will stand the motor vehicle traffic.

Pave with BITULITHIC

NEW BEDFORD, MASS.
Pleasant Street, showing old Macadam before paving with Bitulithic.



NEW BEDFORD, MASS.
Pleasant Street after paving. Bitulithic surface laid over old Macadam.

"Over the Top" of old macadam and old pavement surfaces (which are too far worn to be of further value as a pavement surface but still of value as foundation for a new surface), **thus saving the expense of new concrete base.**

BITULITHIC

is the city's best asset—Pave the right way—it is the only method that pays.

Keep your streets well paved—

Insist on BITULITHIC

Help "win the war" by affording good streets for motor transportation.

All to gain—Nothing to Lose.

STOP – THINK – ACT.

Investigate BITULITHIC—It is the pavement worth while.

Write for Illustrated Booklets.

Warren Brothers Company

Executive Offices: BOSTON, MASS.

DISTRICT OFFICES:

NEW YORK, N. Y. ST. LOUIS, MO. PHOENIX, ARIZ. MONTREAL, P. Q. NASHVILLE, TENN.
CHICAGO, ILL. LOS ANGELES, CAL. UTICA, N. Y. PORTLAND, ORE. SAN FRANCISCO, CAL.
TORONTO, ONT. WINNIPEG, MAN. RICHMOND, VA. VANCOUVER, B. C.

This Truck Hauls Two Warner Trailers in addition to a Capacity Load.

Capacity Tripled by the use of Warner Trailers

This truck is operated by the Highway Commissioners in Portage County, Wis. It is loaded to full capacity. Then two Warner Trailers are hitched behind. Each of them carries a load equal to the truck.
Mark that three times the capacity of the truck is carried and only at a slight increase in expense. One driver handles the work. Only one power plant is in use, but that one is working at full capacity. Half of the power is not wasted as when a truck is operated singly.

The New-Day Method of Handling Hauling Problems

All truck manufacturers concede that the power plant develops enough drawbar pull to haul a load at least equal to the one the truck carries. Warner Trailers utilize this surplus power which is ordinarily wasted. Drivers are saved. Time is saved, also costly equipment.
An important advantage of trailer hauling is that the truck can drop the trailer at one point, go to another to discharge its load and pick up the trailer upon the return trip.

A Motor Truck Minus the Power Plant

Warner Trailers are of sturdy construction throughout. Built like a motor truck without a power plant, but with certain added features to increase efficiency. Performance guaranteed. Thoroughly practical for operation wherever a motor truck can be used. Reversible so they can be hitched or steered from either end.

Many exclusive Warner features, including our patented Universal Ball and Socket Hitch. No coupling pins. Operates like your shoulder joint. Allows for every conceivable position of the truck or trailer. Eliminates all binding strain in going over bumps, around corners or when truck is going up hill and trailer coming down, even at extreme angle.

A Size and Type for Every Hauling Need

We furnish both two and four-wheel Warner Trailers. Chassis alone, or special bodies.

Our expert transportation engineers will gladly make a survey of your problems and make recommendations on equipment best suited to your needs. No charge for this service and no obligation.

Write to us for further data and heavy-duty Truck Trailer Folder giving specifications, photographs of trailers in service, etc., etc.

WARNER MANUFACTURING COMPANY

100 Bushnell Avenue **BELOIT, WISCONSIN**

Inter-city trade in the future will largely be handled by motor. Warner Trailers make possible the truck trains necessary to such service.

WARNER HEAVY DUTY TRUCK TRAILERS TWO AND FOUR WHEEL TYPES